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FARM and HOME DRYING of FRUITS and VEGETABLES

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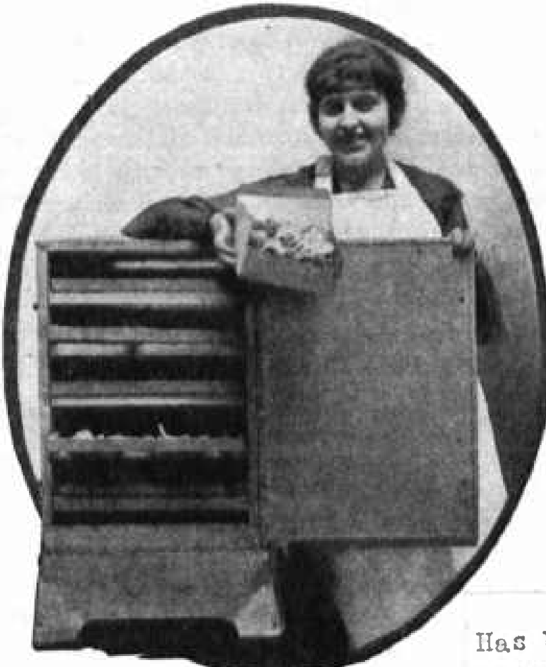

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Wm. A. Taylor, Chief

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IMPERATIVE NECESSITY demands nation-wide conservation of those portions of our food crops which have heretofore been permitted to go to waste. A considerable portion of this wasted food material is made up of perishable fruits and vegetables produced in home gardens and fruit plats in excess of the immediate needs of the producers and in the absence of accessible markets for the surplus.

Drying offers a simple, convenient, and economical method for preserving food materials and permits the carrying over of the surplus into periods in which fresh fruits and vegetables are expensive or unobtainable.

Success in drying depends upon the observance of a few fundamental principles, and the quality of the product depends upon the care employed in the selection of the raw material, upon proper preparation for drying, and upon careful control of the temperatures employed, rather than upon the particular type of evaporating apparatus employed.

In districts which normally have a rainless period coinciding with the ripening period for fruits and berries, these crops may be successfully dried in the sun or by means of glass-covered solar driers. In regions which do not have such favorable climatic conditions, driers employing artificial heat must be used. A number of driers are described and directions for their construction given in this bulletin. The smaller sizes are adapted to the needs of the individual home and are designed to care for the surplus of garden products and fruits from the home grounds. The larger types are suited to the needs of individuals or communities having a considerable surplus of perishable crops. Wherever possible, the members of a community should cooperate in constructing one of these larger types. All the driers described have been thoroughly tested in practice and are such as may be constructed at very moderate expense from materials everywhere available by any one who can use ordinary tools.

Directions for the preparation, drying, and subsequent storage and care of the dried products are given fully for each of the more important fruits and vegetables.

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FARM AND HOME DRYING OF FRUITS AND VEGETABLES

POSSIBILITIES AND LIMITATIONS OF DRYING

DRYING is an important means of preventing loss of perishable foods. The war has brought to our people a general realization of the value of those food materials whose annual loss has heretofore been disregarded and of the necessity for putting an end to such waste. We had almost forgotten that the unused surplus of our gardens and orchards has a food value, pound for pound, as great as that of the portion which we are able to consume immediately, and it has required the stern teaching of necessity to remind us of that fact. We now have definitely before us the task of learning methods of conservation of vegetables and fruits which have long been familiar to most of the world, as they were to our parents, and which are new only to us. When we have learned these methods thoroughly and have applied them to the preservation of the great surplus of fruits and vegetables everywhere produced by small home gardens and orchards, we shall find that our food supplies in the country at large are very materially increased in both variety and quantity. To have available in the home a supply of such foodstuffs considerably reduces the cost of feeding the family, renders it in some degree independent of variations in the supply of foods in the markets, and at the same time permits a broadening and enrichment of the dietary which is a very substantial aid in the preservation of good health.

For preserving perishable foodstuffs, one of two general methods may be pursued. One of these consists of heating to destroy decay-producing organisms, and sealing. This is what we do in canning. The other removes so much moisture from the material that organisms are not able to grow and multiply in it. This is evaporation or dehydration. In the case of any particular material, judgment must be exercised in determining whether it shall be dried or canned.

Drying has the very great advantages that the product has a weight only one-fourth to one-ninth that of the fresh material; that there is a very considerable reduction in bulk, due both to actual shrinkage and to the fact that all portions not actually fit for food are removed; and that the dry material may be stored almost indefinitely without danger

of deterioration and without the use of expensive special containers. At the same time it must be understood that evaporation has very definite limitations and that it is not applicable by any means to all fruits and vegetables. There are a considerable number of fruits and vegetables which it is not advisable to attempt to dry, either because they undergo changes in drying which render them unpalatable or because they deteriorate rapidly after drying; also, there are a considerable number of vegetables which are so readily kept for long periods in storage, either in out-of-door storage pits or in an ordinary cellar, that any labor expended in drying them under any ordinary conditions would be wasted. Hence, this publication confines its discussion of drying to a limited number of fruits and vegetables which are not readily kept in storage and for which methods of drying have been so thoroughly worked out that the amateur has only to follow directions with a reasonable degree of care and intelligence in order to be sure of success.

The equipment described in the following pages has been thoroughly tested in practice and in so far as possible is of simple, inexpensive character, easily built at home and designed to give maximum capacity with minimum costs of construction and operation. The purpose in view has been not merely to describe methods for the conservation of food; it has been considered essential to make sure that the product obtained shall be worth more than has been expended in saving it.

FUNDAMENTAL PRINCIPLES OF DRYING

Most failures in drying are due not so much to imperfections in the equipment used as to the failure of the operator to understand a few fundamental principles which must be kept clearly in mind if the work is to be successful. The purpose in view in drying any food material is not merely the removal of sufficient water to insure good keeping; it is equally important to preserve all the food value of the product with as much as possible of the natural flavor and cooking quality characteristic of the raw material. This double purpose can not be successfully accomplished unless certain guiding principles are kept in mind.

The air at the earth's surface is capable of taking up and holding as water vapor considerably larger quantities of moisture than are ever present in it; that is to say, the free atmospheric air never becomes completely saturated. Consequently, any wet material exposed freely to the air will ultimately become dry, since the liquid water covering its surface will be converted into water vapor and taken up by the air. The rate at which this will occur will depend upon the temperature of the air and upon the percentage of moisture already present in it when

brought into contact with the material. If the air remains at constant temperature and is undisturbed by currents, the loss of water from the material will go on very slowly, as the air nearest the wet surface will soon become almost saturated and can take up more water vapor only as that which it already holds is lost by diffusion outward and upward into layers of drier air. If the air be kept constantly in motion, however, the drying will be greatly hastened, as the moving air current will displace the blanket of moist air surrounding the material as rapidly as it is formed and bring in drier air to replace it. If the temperature and moisture content of the air used are both constant, the rate of drying will increase proportionally as the rate of movement of the air is increased, until a point is reached at which water can not pass from the interior to the surface of the material as rapidly as the air is able to take it up, when the surface will become dry even though the interior is still nearly saturated. The effect of a brisk breeze in hastening the drying of the surfaces of muddy fields after a rain is a familiar illustration of this principle.

Drying is also hastened by raising the temperature of the air. The amount of water vapor which a given volume of air can absorb before reaching saturation depends upon the temperature and is practically doubled by every increase of 27 degrees in temperature. In other words, if a quantity of air be warmed from 60° to 87° F., its moisture-carrying capacity is doubled; if the heating be continued until a temperature of 114° is reached the moisture-carrying capacity is again doubled, becoming four times what it was at 60° F. Further heating produces further increases in the same proportion, until a point is again reached at which water is vaporized at the surface more rapidly than it is replaced by movement outward from the interior of the material, when the process will, of course, be slowed and stopped by the drying out of an outside layer, which will then retard the escape of moisture from the tissues beneath it.

There are therefore two ways in which the rate of drying can be increased; namely, by increasing the temperature of the air or by quickening its rate of movement over the material to be dried. Economical drying is secured by combining the two and forcing currents of heated air over the material at such temperature and rate of movement as will remove moisture from the surface as rapidly as it can move outward from the interior of the fruit or vegetable being dried. When this point has been reached, any expenditure of heat in further warming the air or of force in driving it is, of course, wasted.

Generally speaking, flavor and cooking quality are best preserved by rapid drying. Fruits and vegetables are living things; when their flesh is opened up to the air, as occurs in peeling and slicing, a number

of chemical changes in the tissues immediately begin. If the material is to retain its natural appearance, color, and flavor, these must be checked. Some of these changes produce darkening and discoloration of the tissues; others break down the pigments present, causing the fading of the characteristic colors of the material; and still others affect the flavoring substances present, producing decrease or loss of the constituents which give the fruit or vegetable its characteristic flavor. Other accompanying but slower changes result in the partial destruction of the sugars and proteins of the material, sometimes accompanied by the production of new and undesirable flavors and odors. While these changes are in part spontaneous, many lower organisms, universally present in the air and upon foodstuffs—bacteria, yeasts, and molds—which produce similar but much more rapid decomposition, are certain to begin growth in the material as soon as the removal of the protecting peel gives them access to its interior. Consequently, processes of decomposition begin as soon as the fruit or vegetable is opened to the air and will continue until the greater part of the moisture present is removed unless special means are employed to arrest them. This decomposition would be immediately stopped by raising the temperature of the material to 175° or 185° F., but it is not possible to do this without causing injury. The rapid heating to this temperature in dry air of freshly cut slices of a succulent fruit or vegetable causes bursting of the cell membranes by expansion of their contents and permits the escape of water which carries with it dissolved sugars, salts, and flavoring substances, thus reducing both the palatability and the food value of the product. Consequently, only moderate temperatures can be employed, and unfortunately all, or practically all, the changes under discussion are not only allowed to continue but are actually hastened when the temperature of the fresh water-filled material is raised to the limit beyond which bursting and dripping will occur. To arrest these changes and to preserve the natural colors and flavors of the material it is necessary to resort either to blanching or sulphuring, both of which are discussed elsewhere.

It follows from the foregoing statement that rapid drying can not be secured by the employment of high temperatures with fresh water-filled material. Nor can material already partially dry be subjected to high temperatures, as scorching and charring will then occur. The best temperature for drying is therefore the highest which can be employed without danger of injury in either of these ways, since the drying will thus be made most rapid. What this highest possible temperature may be is determined in the case of any particular fruit or vegetable by its physical structure, chemical composition, and water content. As the different fruits and vegetables show very wide varia-

tions in these respects, there is no single best temperature for general use with the various products; heat treatment which would be perfectly safe with potatoes or carrots would be utterly ruinous if applied to such fruits as raspberries and peaches. For this reason it has been necessary to determine experimentally for each of the different materials the range of temperatures which may be employed without injury. These are given on subsequent pages. The operator of a drier should be provided with a dependable, accurate thermometer which should be placed in the drier and kept under frequent observation, as any attempt to trust to inexperienced judgment as to temperatures in the drier is likely to result in damage to the material.

In drying any food material it is absolutely indispensable that provision be made for the prompt removal of moisture from the apparatus by a constant inflow of air. The reason is obvious; if the material be placed in a closed box and heated the confined air will very quickly become saturated and no more water can escape from the material. If the heating is continued, the material will literally be cooked in its own juices, since the water content of the products which we dry ranges from seven-tenths to more than nine-tenths of their total weight. Therefore, a drier can be efficient only in the degree that its construction provides for constant removal of the moisture given off by its contents.

Success in drying, therefore, depends upon the stopping by suitable means of the series of changes which begin as soon as the material is cut into pieces and exposed to the air, the employment of a temperature sufficiently high to prevent the growth of organisms—yet not so high as to produce the bursting of cells and loss of juices in fresh material or the scorching of that which has lost most of its water—and the provision of an adequate circulation of air for the prompt removal of the water vapor given off. Simple as these principles are, they have been discussed at length for the reason that most failures or poor results are due to the neglect of one or more of them.

METHODS AND EQUIPMENT FOR DRYING

CHOICE OF A METHOD

Wherever climatic conditions make it possible, sundrying is the least expensive method of preserving foodstuffs. Successful sundrying demands that a rainless season of bright sunshine and high temperature coincide with the period at which the crops to be dried are maturing, and the extent to which sundrying can be carried on in any district is determined by the length of its rainless midsummer and autumn period. Ideal conditions for sundrying all fruits, both early and late, are found in the interior districts of California, where sundrying has become an

industry of large proportions, and throughout the Southwest. In the intermountain region of the Northwestern States, over the larger part of the Great Plains area, and in all but the coastal portions of the Southern States, the sundrying of such early-maturing fruits as berries, cherries, apricots, and peaches is everywhere possible. In much of this territory, warm, rainless weather usually continues sufficiently far into the autumn to permit sundrying of such late-maturing fruits as apples, pears, and plums, as well as of such vegetables as sweet corn, pumpkin, and squash. Outside these areas and in any region in which the late summer and early autumn are characterized by frequent rainfall or periods of low temperature and high humidity it will not be wise to depend wholly upon sundrying, as a few days of rainy weather may cause the loss of a large amount of valuable material.

As ordinarily conducted, sundrying in the open air has the disadvantage that the drying material is exposed for a considerable length of time to the visits of insects which deposit their eggs in it and also to dust borne by air currents. Insects may be excluded by providing the trays in which the material is dried with covers of mosquito netting, tacked tightly in place over the top, but such covers do not wholly prevent the entrance of dust. Both dust and insects are excluded if one of the glass-covered solar driers described in a subsequent paragraph is employed, and a device of this character should be used in any district in which high winds carrying much dust prevail during the drying season.

The use of artificial heat in drying has the advantage that the work is thereby made independent of weather conditions and that it is possible to dry a considerable number of foodstuffs which ordinarily can not be dried in the sun; for example, winter varieties of apples, prunes, and such vegetables as potatoes and carrots. It has the disadvantage that it requires close supervision in order that overheating and subsequent injury to the material may be avoided, but if the work is properly done the products will retain their natural appearance and flavor to a greater degree than it is possible to secure in sundrying. The process is more expensive than sundrying, since an evaporator must be constructed or purchased and a supply of fuel provided. For the individual family the investment represented by the evaporator need not be a burden; anyone who can use ordinary tools can construct in spare time and with a trifling outlay for material any one of the cookstove driers herein described, while the heat of the stove or range employed for cooking can be utilized for operating the drier. If this homemade equipment is properly constructed it is quite as efficient as the similar small driers sold on the market at several times its cost.

The community in which home gardens and fruit plats produce a large surplus of perishable food materials, or in which the individual grower

has a considerable quantity of fruit which is unmarketable in the fresh state, will require an evaporator of larger capacity. Here, again, the investment need not be large and may be made principally one of labor rather than of money. Some existing unused building may be used to house the evaporator and to furnish a workroom in which the preparation of the material may be carried on; a boiler, furnace, or large heating stove already on hand may be employed as a source of heat; and the evaporator itself may be constructed largely or wholly in spare time by the parties interested. For this reason the plans for the larger evaporators presented in this publication are purposely so generalized that the individual community or grower may adjust the size and capacity to the needs of the particular case, and at the same time the plans are so detailed that an experienced builder will not be needed to supervise the construction.

PREPARATION OF THE MATERIAL

The equipment needed for the preparation of the material for drying depends primarily upon the quantity and character of the various products to be dried, and to some extent upon the conditions under which

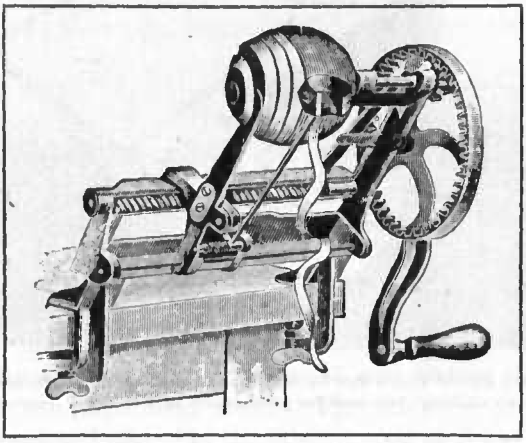

FIG. 1.—An inexpensive but durable apple parer which pares, cores, and slices the fruit in one operation

the work is done. Where the work to be done is limited to caring for the surplus from a small home garden or a few fruit trees and the quantity of any one product is only a few bushels, the purchase of special machines is neither necessary nor advisable, as the kitchen equipment will contain everything absolutely necessary. Two cheap kitchen

knives, one with a short, narrow, rather stiff blade, for use in paring and trimming, the other with a longer, flexible blade, for use in slicing, are all that will be needed for paring, trimming, and slicing small quantities of apples, pears, apricots, peaches, onions, potatoes, carrots, beets, and other vegetables. If saving of time rather than economy of expenditure is a primary consideration, or if the quantities of the various materials are considerable, the individual household may advantageously secure several special machines. For handling apples in considerable quantities, one of the small hand-paring machines which peel and core or peel, core, and slice in one operation will save much time.

A number of machines similar to that shown in figure 1 are on the market at prices ranging from $1.75 to $2.50. While these low-priced

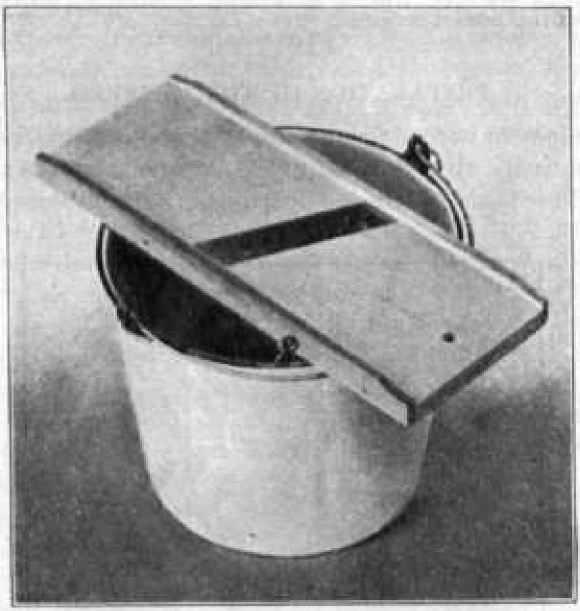

FIG. 2.—A kraut cutter which can be used not only in the preparation of cabbage for drying or kraut making, but also for slicing any of the larger vegetables or fruits

machines are not sufficiently strong to stand up under continuous heavy usage, they will serve all the needs of the ordinary family for several seasons. A kraut cutter of the type illustrated in figure 2 will be an aid not only in preparing cabbage for drying or for making sauerkraut, but it can also be used in slicing potatoes, carrots, onions, pumpkin, squash, or any of the larger vegetables or fruits. Any blacksmith can make cutting blades for such an inexpensive homemade device. A somewhat more expensive type of slicing machine

is the rotary slicer of the type shown in figure 3. This is made in several sizes at prices ranging from $2 to $12. These machines will slice a great variety of products and may be so adjusted as to cut

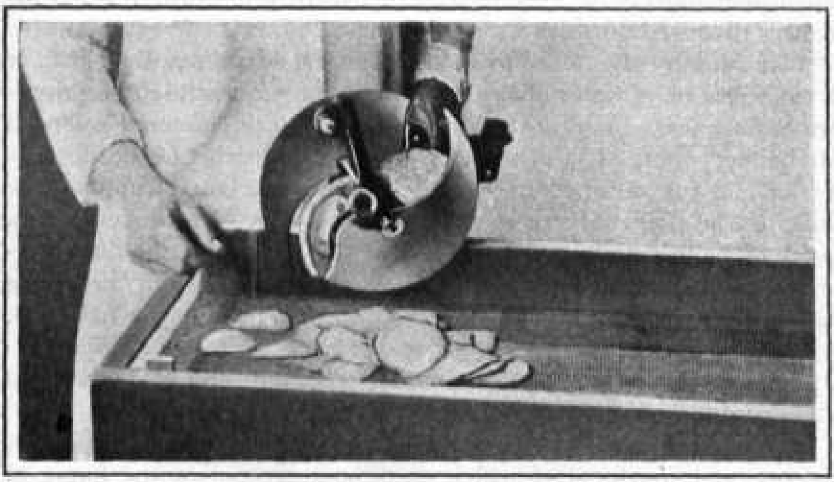

FIG. 3.—A rotary slicer which may be adjusted to cut slices of any desired thickness

uniform slices of any desired thickness, thus securing greater regularity in drying than is possible when the slices are of varying thickness.

For blanching and steaming such vegetables as require this treatment, the most convenient device for use in the home is a wire basket, made from heavy window screening or wire netting, of such size and shape that it can be placed inside an ordinary tin wash boiler. In use the wash boiler is placed upon the stove and partially filled with water, a wooden frame or a few bricks are placed in the bottom so as to project an inch or more above the water, and the water is brought to vigorous boiling. The vegetables are placed in the wire basket as they are prepared and are blanched by removing the lid of the boiler, placing the basket upon the supports, replacing the lid, and leaving the material in the steam for the prescribed time. The material then should be spread upon trays and placed in the drier as soon as it has been allowed to drain for a moment. In larger plants where a source of steam is available, a steam box may be constructed. This may be merely a rather tight wooden box of convenient height and of the proper width and depth to receive trays carried upon cleats nailed to the sides, or the vegetables may be placed in open slatted crates raised upon blocks a few inches above the floor. Live steam is led into the box from the boiler by a pipe or steam hose fitted with a cut-off valve. Trays or

crates loaded with the prepared vegetables are inserted, the door of the box is closed, and the valve is opened to admit steam, which is allowed to flow in for the prescribed period. In every case, material should be blanched as quickly as possible after preparation, in order to avoid the changes discussed on page 8.

Blanching by the use of live steam has the advantage that little or no condensation of water upon the material can occur, and drying therefore begins more promptly than is the case when the material is dipped into boiling water. If it is not possible to employ either of the methods of blanching just outlined, fairly satisfactory results may be obtained by plunging the prepared vegetables, contained in a wire basket, into a vessel of boiling water. If this method is employed, the time prescribed for the treatment of each vegetable in the section on "Preparing and drying vegetable products," pages 47 to 56, must not be exceeded, as the prolonged action of boiling water removes such valuable constituents as sugars, salts, and flavoring principles and also results in subsequent loss of natural color and appearance.

If the drier handles considerable quantities of apples, peaches, apricots, and pears, all of which must be subjected to the fumes of burning sulphur in order to prevent darkening during drying, some form of sulphuring box must be provided. This should be placed outdoors, in order that the workers about the plant may not be annoyed by the irritating fumes of the sulphur. For small driers the sulphuring box may be simply a packing box or a wooden frame covered with light boards, building paper, or canvas, sufficiently large to inclose a stack of trays. The trays are stacked upon two blocks of wood so as to raise the lower tray several inches above the ground, sulphur is ignited in a heavy metal vessel, such as an old saucepan, placed beneath the stack, and the box is inverted over the whole and allowed to remain for the requisite time. In larger plants a cabinet large enough to receive 10 or 15 trays, placed one above another upon cleats fastened to the sides and with space for a sulphur vessel at the bottom, should be constructed; or if the plant has a steam box, such as is described on page 13, it may also be used as a sulphuring chamber.

When prunes are to be dried, provision must be made for dipping them in a hot lye solution, to check the skin and thus facilitate drying. A prune-dipping outfit consists of a vessel, preferably enamel lined, of suitable size to contain the lye solution, some means of keeping this vessel at boiling temperature, a basket or old bucket with the sides punched full of holes to serve as a dipping vessel, and a tub of clean, cold water in which the prunes are rinsed free of lye after dipping. In operation, the kettle is filled with a lye solution made by adding 1 pound of commercial concentrated lye to 10 gallons of water. This is

heated to boiling. The fruit is placed in the dipping vessel and plunged into the solution for 30 to 45 seconds, then withdrawn and immediately transferred to the vessel of cold water, where the basket is moved about in the water for a minute or two to wash off the lye. The fruit is then at once spread upon the trays and placed in the drier.

When considerable quantities of peaches are to be dried and it is preferred that they be peeled, the same equipment and the same strength

FIG. 4.—A potato peeler which may be used for paring any of the root vegetables

of lye solution may be used. Peaches are dipped into the boiling lye for one-half to 1½ minutes, the exact time depending upon the variety and being determined by the cracking or splitting of the skin. They are then thoroughly washed in cold water and the peels rubbed off between the hands or by rubbing gently against a wire screen and rinsing. They are then halved, the stones are removed, and they are spread on trays. Peeled peaches can not be successfully sulphured, as there would be a loss of juice from the peeled surfaces.

In larger community or farm plants where considerable quantities of several of the leading fruits and vegetables of the locality are to be

dried, the purchase of a number of special machines is advisable. Such a potato peeler as is shown in figure 4 will successfully pare either white or sweet potatoes, parsnips, carrots, turnips, or beets, leaving only a relatively small amount of work to be done by a trimmer, and will quickly pay for itself if large quantities of these vegetables are to be dried. The machine is very simple; it consists of a large cylindrical chamber having a carborundum or perforated steel lining against which the contained vegetables are thrown by centrifugal force when the crank is rapidly turned. The peels are thus scraped or ground off and carried out of the peeler by a stream of water supplied from a

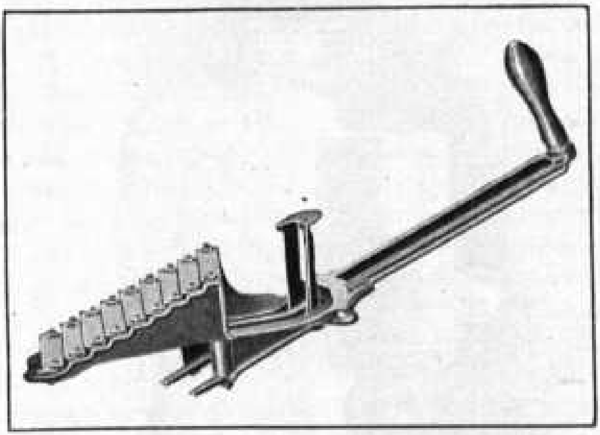

FIG. 5.—A simple and durable apple slicer which can be used equally well in slicing any of the smaller vegetables

reservoir at the top of the machine. Such a machine with a capacity of 9 bushels of potatoes per hour will cost approximately $50. One of the larger rotary slicers, so made that it will accommodate half a head of cabbage as well as smaller vegetables, will also be a good investment.

For paring apples in quantity, a substantial, well-built hand-power machine having a capacity of 5 to 8 bushels per hour will cost about $14. If a source of power is available and the quantity of apples is such as to justify the expenditure, one of the standard power-driven machines may be obtained at prices ranging, for the various makes, from $25 to $37. A hand slicer of very simple and durable construction (fig. 5), capable of slicing from 50 to 70 bushels of apples a day, may be obtained for $6; it may also be used for slicing the smaller, more compact vegetables, such as potatoes, carrots, turnips, beets, and onions.

DRYING WITHOUT ARTIFICIAL HEAT

DRYING IN THE OPEN AIR

Small quantities of berries or other fruits may be dried in the sun without making trays for the purpose, as the products may be spread upon clean boards, canvas, heavy wrapping paper, newspapers, or sheets of muslin held in place by strips of lath laid along the edges. The sloping roof of a woodshed or a low porch which has a southern exposure will serve admirably as a place in which to expose such small lots. For larger quantities trays will be necessary. They should be made of uniform size, for convenience in stacking, and should not be too large to be handled conveniently by one person when loaded with fruit. The lumber used should be as light as is consistent with durability. The frame of the tray may be made of 1 by seven-eighths or 1 by 2 inch strips placed on edge, and the bottom may be made of ordinary plastering laths, of light boards taken from packing boxes, or of light lumber purchased especially for the purpose. The bottom should be solid, with only very narrow spaces between the boards. To give the tray greater strength and to prevent the warping of the bottom, three 1 by seven-eighths inch strips may be nailed across the bottom at the center and ends. These should be allowed to extend flush with the sides of the tray, as they will then hold the trays slightly apart when they are stacked, thus insuring a prompt penetration of sulphur fumes in the sulphuring box and a good circulation of air through the partially dried fruit when the trays are stacked at night or during unfavorable weather.

If insects abound during the drying season, their visits to the drying fruit may be prevented by cutting pieces of muslin or cheesecloth somewhat wider and longer than the trays themselves, stretching one of these tightly over the top of each tray as it is filled, and fastening it in place with carpet tacks pushed into the edges of the frame. Trays should not be placed directly upon the ground while drying. If the ground be bare, the surface will become pulverized and much dust will fall upon the fruit; if it be covered with turf, the evaporation of water from the grass will form a vapor blanket which will retard the drying. Consequently, an elevated platform or scaffold raised several feet above the level of the ground should be built to receive the trays. This will permit the free movement of air currents beneath as well as over the trays, which will materially aid the drying. Posts may be driven into the ground and strong poles or pieces of 1 by 4 inch scantling nailed to them so as to support a series of rows of trays. The platform should be inclined somewhat, so that the trays will face toward the south or southwest, as the fruit will thus receive the full effect of the sun's rays for a longer time. If possible, the location chosen for outdoor drying

should be one covered with turf which is kept closely cut, in order that the movements of attendants may not stir up clouds of dust which will settle upon the product, and for the same reason the drying ground should be as far as possible from a dusty road or plat of bare ground.

SOLAR OR OUTDOOR DRIERS

The principle involved in the solar drier is exactly that of the cold-frame or forcing box. The drier is essentially a ventilated box with an inclined glass top so placed that the rays of the sun fall directly upon the glass for as many hours as possible each day. The box receives heat from the sun's rays more rapidly than it is lost by radiation to the surrounding air; hence, it is warmed up in bright sunlight to a point considerably above air temperature. If such a box is provided with screened ventilators, so that there is free circulation of air, the material in the box will lose moisture more rapidly than would be the case in the open; consequently, some type of solar drier will be especially useful in districts which have only moderate temperatures during the fruit-drying season. If all openings into the box are carefully screened the contents will be quite effectively protected from dust and insects; hence, a drier of this type will be especially valuable in windy, dusty districts or amid surroundings in which insects abound, as well as in territory which has relatively short periods of hot, dry weather.

A very satisfactory solar drier may be made from an ordinary window sash and a packing box having a length 2 inches less than that of the sash, a breadth 3 to 4 inches less, and a depth of 18 to 24 inches.[1] (Fig. 6.) Remove the boards from the longer sides of the box, leaving the ends and bottom fastened together. The ends must now be cut off so as to give the top the desired inclination. Measure off 10 inches from the bottom of the box along the edges of the end pieces at one side; upon the opposite side measure off 20 inches; draw a line between these points and saw off the ends along these lines. This gives a frame for a box 20 inches in height at the higher side or back and 10 inches high at the front. Select from the boards removed from the sides two straight-edged pieces each about 4 inches wide; nail one of these to the two end pieces at the back, with its upper edge exactly flush with the upper edge of the end pieces. Now lay the sash in place and nail the second long strip in place at the top of the front of the box, taking care that the sash makes close contact at all points with both sides and ends. At the back of the box measure off 6 inches from the lower edge

[1] If the family happens to have a forcing frame equipped with glass sash and so placed that it has a good southern exposure, it may be converted into a solar drier by utilizing the suggestions to be found in the directions for making a solar drier. Repair the sash, if necessary, to make them water-tight, remove a board near the bottom at the front side and another near the top at the back, and replace them with screening to secure ventilation, and provide trays such as are described on page 40 upon which the material may be spread.

of the top board; leave this space open to serve as a ventilator and board up the remaining distance solidly. There is a similar 6-inch open space at the front between the top board and the floor of the box which is also to serve as a ventilator. Cover both ventilating openings with close-meshed wire cloth, such as one of the better grades of mosquito-proof netting, turning in the free edges so as to give a smooth surface which will not catch the clothing of the operator. Attach the window sash by two light hinges to the strip forming the top of the

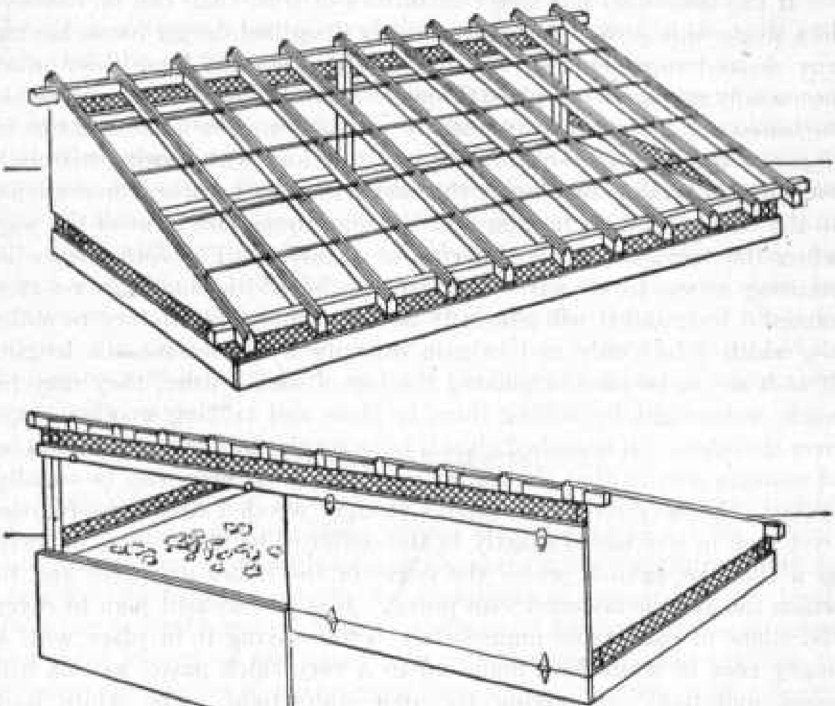

FIG. 6.—A solar drier which protects the contents from dust and insects while shortening the time required for drying

back of the drier, so that it may be easily raised and lowered to get at the contents. With a plane, go over all surfaces upon which the sash rests, smoothing them down so that the sash fits closely, to exclude insects, and the drier is complete. For convenience in handling the material a tray fitting into the bottom of the box may be made, or the products to be dried may be spread upon papers or canvas placed upon the bottom boards.

Such a drier should be placed where the sunlight will fall directly upon the sloping glass surface for as many hours as possible each day,

and the drying will be accelerated if the position of the box is changed two or three times daily in accordance with the movements of the sun, as the absorption of heat is much greater when the rays fall directly upon the glass surface than when they strike it obliquely. If the sash is carefully looked over at the beginning of the season and any breaks in the putty repaired so that no water can reach the contents even in hard showers, the drier may be permanently located at some convenient place in the open.

If the household has larger quantities of fruit than can be handled in a single unit such as has been already described, larger forms having any desired capacity may be constructed. Since a large drier must necessarily remain in one place throughout the season, it will be advisable to fasten the glass top permanently in place and to make a series of doors at the back of the drier for inserting and withdrawing material. Such a door is made by hinging the back, either as a whole or in sections, to the bottom in such fashion that the door drops down out of the way when the trays are to be inserted or removed. For convenience in securing access to all parts of the drier the width should in no case exceed 5 feet, and it will generally be found more satisfactory to make the width 4 feet only and to gain capacity by increasing the length. If sash are to be used in making the top of such a drier, they may be made water-tight by nailing them in place and tacking wooden strips over the edges. If unsashed glass is to be employed, the panes should be of uniform size, so that the rafters which support them may be equally spaced. Each rafter should have a straight wooden strip three-fourths by 1 inch in size nailed exactly in the center of its upper face, to serve as a shoulder against which the edges of the panes may rest and to which the glass is fastened with putty. It is an excellent plan to cover the edges of each pane immediately before laying it in place with a heavy coat of white lead made up to a very thick paste, as this will assist materially in making the roof water-tight. The white lead should be allowed to become thoroughly hard before the putty is put on.

DRYING WITH AN ELECTRIC FAN

Where cheap electric power is available, the housewife who already possesses an electric fan and who expects to dry only occasional small lots of material which do not justify the construction or purchase of an evaporator can make very acceptable products by drying before an electric fan, provided always that special care is employed in the preliminary treatment of the materials. For holding the products while drying, trays of wire screen 15 to 18 inches in width and about 3 feet in length are made; these have sides 2 or 3 inches in height, while one end, and preferably both ends, should be left open. The materials to

be dried are spread in a thin layer upon the trays, and these are stacked one upon another with the open ends turned toward the fan, which is placed close to the end of the stack and run at moderate speed, thus driving large volumes of air longitudinally over the trays. As the material will dry at the end nearest the fan much more rapidly than at the opposite end, the stack of trays should be reversed after 4 to 6 hours, and again after a longer interval. In order to exclude insects from the material, a piece of mosquito bar or cheesecloth large enough to cover the stack of trays is spread over them and so fastened at the ends and side that the currents of air from the fan will not displace it.

Since by this method the entire drying process is carried on at ordinary room temperature, the enzyms which produce discoloration and other changes in the material are not destroyed, as is the case in products subjected to heat. Consequently, there will necessarily be considerable discoloration in apples, peaches, pears, or apricots which are dried without blanching or sulphuring. In those vegetables for which steaming or blanching is recommended, the process must be continued for the full time specified or serious deterioration is likely to occur. For the same reason, all products dried before a fan should be heated to 165° or 170° F. in an oven for 10 to 15 minutes before they are finally stored.

DRYING WITH ARTIFICIAL HEAT

In making choice of an artificially heated drier from the wide variety of devices which are available, regard should be had (1) for proved convenience and economy of operation and (2) for suitability, both in capacity and in first cost, to the quantities of material to be dried. To invest several hundred dollars in equipment for drying a few hundred pounds of low-priced raw material is as bad economy as to attempt to conserve the surplus of a good-sized gardening community with a device better suited to the needs of a single family, since both cases result in financial loss.

In choosing between simple and inexpensive homemade driers and the more elaborate and costly commercial driers, it should be clearly understood that increased efficiency and quality of product do not by any means follow increase in cost. The quality of the product made with any type of drying device depends upon the grade of the raw material used, the employment of proper methods of preparation for drying, and upon the temperatures to which the material is subjected during drying rather than upon the nature of the drier used. Low-grade and improperly prepared material will give mediocre or poor products even though the most elaborate drying equipment be used, while anyone who thoroughly understands the proper methods, when given good material,

will produce an excellent product even with the crudest of makeshifts. No drier can do more than merely to contain the material while its moisture is removed by currents of warm air. Various devices may be employed to hasten the process, to increase the efficiency of the fuel used, and to give more complete control of the temperature, but the essential principles of all these devices have long been understood and are common property. The claims of some makers of patent evaporators that their machines turn out highly superior products which it is otherwise impossible to produce have no more basis in fact than their claims that other methods of evaporation necessarily give products devoid of food value and unfit for human consumption. The older, generally employed, nonpatented driers failed to give uniformly high-grade products, not by reason of inherent defects in construction, but because of the general employment of low-grade material for drying purposes and the fact that too little attention was given to the details of preparation or to cleanliness in the handling of the product during and after drying.

COOKSTOVE DRIERS

For meeting the needs of the ordinary family there are a considerable number of small driers, both patented and unpatented, intended to be operated over the cookstove and in connection with the usual routine of the kitchen. In plan, these range from single trays, or open racks supporting several trays, to be suspended from the ceiling, to strongly built all-metal cabinets with a capacity of 1 to 2 bushels at a single charge. A number of these, varying considerably in capacity and in first cost, are here described, in order that the housewife may make choice of a size and type suited to her needs.

In many cases the housewife will find it possible to do without special apparatus and to dry such materials as she wishes to preserve in the oven of the cookstove. The products to be dried should be spread thinly in baking pans or pie tins and these should be placed upon racks so that they are not in direct contact with the oven wall. The door of the oven should be left open so that the water vapor driven off may pass out, and the fire should be so regulated that the material may not be scorched. Very satisfactory products are made in this way, and many households dry considerable quantities of fruits by exposing them upon boards or newspapers so placed about the stove that they are kept warm while the stove is in use.

When the amount of material is too small to justify the expenditure of time or money in providing a more elaborate drier, a simple device for suspending trays above a cookstove may be employed. Such a device may have one or more trays, and the number may be increased as

desired. Each tray is made of a rectangular piece of rather heavy galvanized-wire netting having a one-fourth or one-fifth inch mesh. The size of these rectangles is determined in any particular case by the

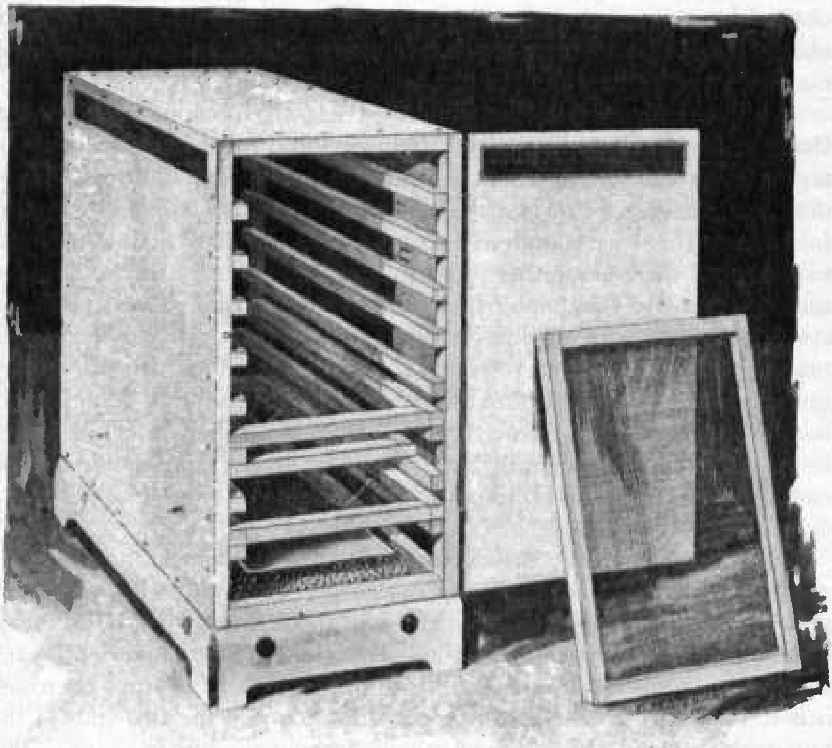

FIG. 7.—An efficient and inexpensive homemade cookstove drier

size of the stove used for heating, and the finished trays should have approximately the same dimensions as the stove top. Each piece is cut 3 inches larger each way than the finished tray is to be, a diagonal cut extending inward 1½ inches is made at each corner, and the edges are turned up so as to form sides for the tray. It is a good plan to turn the free edges of the netting inward and flatten them down with a hammer in order that there may be no projecting ends of wire to tear the hands or clothing. Four pieces of light laths 1 by 2 inches in thickness form the frame of the drier, to which the individual trays are attached by wire staples driven through the upturned edges of the trays into the slats of the frame. Two wires attached at opposite corners of the top of the frame and crossing at the center give a support by which the drier may be suspended from the ceiling. A light pulley attached

to the ceiling will furnish a convenient means of raising the drier out of the way when the top of the stove must be used in cooking; or the drier may stand directly upon the top of the stove, if the slats making up the frame are allowed to extend 6 inches below the bottom of the lower tray and a good-sized nail is driven half its length into the end of each slat to form noninflammable feet upon which the drier may rest.

A drier such as that just described has the obvious disadvantage that the trays are open to visits by insects and must necessarily arrest more or less dust and also soot escaping from the stove in firing. These disadvantages can be at least partially overcome if the operator is careful to keep the drier completely covered with a tightly fitting mosquito netting; but there is another serious defect which such a device does not remedy, namely, that many foodstuffs which will be cooked upon the stove have strong or distinctive odors, which the drying material will take up, giving the dried products foreign odors which will prove very undesirable. For all these reasons an open drier will be found much less satisfactory than some type of closed-chamber drier to which insects, dust, and odors will have less easy access, and should not be employed where the work to be done warrants the trouble of making a drier of the closed type.

An inexpensive but satisfactory homemade evaporator made from an ordinary packing box is shown in figure 7. The box selected for the purpose should be a strong but light one made from some nonresinous wood and should be about 3 feet in length, with a width and depth each slightly less than the length and width of the top of the stove on which it is to be used. Remove and preserve the top and the two ends of the box, tacking cleats across the open ends to hold the box in shape. The open ends will, of course, form the top and bottom of the completed drier, while the top will be the door. Secure a number of pieces of laths 1 by three-fourths inch in thickness and cut them into pieces equal in length to the depth from back to front of the box when placed on end. These pieces are to be nailed upon the inner surfaces of the side walls, to serve as supports for the trays. Mark off the proper positions for them with a carpenter's square or straightedge, beginning 6 inches from the bottom of the box and drawing lines 4 inches apart to serve as guides in placing the cleats. Nail each in place with its upper edge flush with the proper line. Leave a space of 3 to 5 inches—its exact height is immaterial—above the topmost cleat. From the top of the box make a door, using any light box hinges which may be on hand and providing some sort of fastening, such as a light box catch, for holding the door closed. Nail two pieces of 1 by 2 inch slat across the front at top and bottom for the door to close against. Cut four bits of

2 by 4 inch scantling 6 inches long, drive a 60-penny nail into the end of each piece for about one-third its length, and nail one of the blocks in place in each of the four corners of the bottom of the box, with the nail projecting downward below the edge of the box. The nails thus form legs upon which the drier will stand, thus keeping wooden parts away from contact with the heated top of the stove and permitting the free entrance of air at the bottom of the machine.

If the drier is to be used only upon a coal or wood stove, the bottom may be covered by a piece of strong, heavy-wire mosquito netting, cut to such size that it may be tacked to the side walls. This will serve to exclude insects at such time as the drier must be set off the stove while filled with partially dried fruit.

If the drier is to be used over a kerosene or gas burner, it will be necessary to provide a radiator or deflector to protect the lower trays from the direct flame and to distribute the heat. This may be a rather heavy sheet of galvanized iron, 2 inches less in width and length than the inside dimensions of the drier, and may be supported on wire finishing nails driven through the sides of the drier at the corners. It should be placed 4 inches from the bottom of the lower tray.

If preferred, the top of the drier may be covered with wire netting, thus leaving the whole top open for exit of the moist air, but since it will occasionally happen that heavy objects will fall upon the top of the drier, it is a better plan to make a solid board top which will protect the interior while affording ventilation. To do this, cut four bits of 2 by 4 or 2 by 2 inch scantling each about 6 inches in length; lay one of these diagonally across each corner of the top of the drier in such a position that its ends are flush with the sides, and nail it in place. Next, place one of the ends of the box, kept for the purpose, in position upon these blocks, and nail it down. This gives a 2-inch space on all sides of the top, to serve as a ventilator. Cover this space with mosquito netting like that used in covering the bottom.

Make trays of a good quality of galvanized netting having a one-fourth or five-sixteenths inch mesh, cutting the bottoms 1 inch larger each way than necessary and turning over the margins before fastening them to the frames. Make frames for trays of three-fourths-inch or 1-inch slats, fastening the netting to them with wire staples. If preferred, a reversible tray, such as is described on page 41, may be made by following the method of construction there described. It is an excellent plan to make the trays about 3 inches less in length than the depth of the drier, and to push the lower tray to the back as far as it will go, thus leaving a space in front, then place the second so that the door will just close, leaving a space at the back, push the third back even with the first, and so on as the drier is filled. This alternate arrange-

ment permits movement of the air over the surfaces of the trays as well as through them and aids materially in keeping up the circulation.

If it be desired to avoid the danger of fire which accompanies the use of a wooden drier over a stove, it is not a difficult task to construct a homemade drier of about the size and capacity of that just described, but having all exposed parts covered with metal. A convenient size for use on most stoves is 36 inches in height with a base 24 by 16 or 24 by 20 inches. A frame having these dimensions is made of 1 by 2 inch wooden strips, and wooden cleats for supporting the trays are nailed at intervals of 3 inches to the side pieces, leaving a 4-inch space beneath the lowest tray. The sides are covered with tin or galvanized sheet iron; the top is made of a piece of the same material in

FIG. 8.—A homemade drier constructed of sheet iron in operation over a kitchen range

which two openings, each 2 by 6 inches in size, have been cut to serve as ventilators. These should be closed to exclude insects by tacking a sheet of wire screening to the wooden frame before the metal top is put on. A single piece of galvanized iron, nailed to a wooden frame to give it rigidity and supplied with small hinges and a catch to hold it closed, forms the door. The bottom is covered by a piece of fairly heavy sheet iron in which half-inch openings have been cut with a punch at 2-inch intervals; in order to exclude insects, this should have a sheet of wire netting fastened beneath it before it is nailed on. If the drier is to be used over a direct flame, such as that of a gas stove, a deflector made as described on page 25 must be provided to protect the lower trays from overheating. For supporting the drier when it is placed upon the stove, a base 6 inches high is made by cutting four strips of galvanized sheet iron, somewhat heavier than that used for covering the drier, and riveting them together into a rectangular frame upon which the drier may stand. In order to secure a good current of air through the drier, the base strips are perforated with openings by means of a punch, or a portion of each side may be cut away, as illustrated in figure 7. Trays are made of wire netting, as described in the preceding paragraph, and it is an excellent plan to make them of such size as will permit the alternating arrangement in the drier which is there suggested, as the gain in time during drying will more than compensate for the decrease in capacity.

COMMUNITY DRYING PLANTS

In communities in which almost every family has a home garden, a plat of berries, or a group of fruit trees producing perishable crops in excess of immediate needs for consumption in the fresh state, it will be highly advantageous for those interested to combine in building and operating a community-owned evaporator. Such a plant, if properly planned, will cost much less than the number of small home equipments necessary to care for the same volume of foodstuffs; it will permit the saving of the surplus crops of those who, without its help, would lack the means or the initiative to provide methods for taking care of their material; and it will justify the employment for the season of an experienced person to oversee the work, thus insuring products of better quality than would be made by the undirected efforts of a large number of inexperienced persons.

If the neighborhood be one which already has or is getting under way some form of cooperative enterprise, such as a community canning center, the drier should be established in connection with it and under the same management. Since much of the equipment for preparing material will be equally useful for both purposes, canning and drying

combine to good advantage and may very well use a preparation room in common. If the community has no such enterprise, the drier should be placed as nearly as possible in the center of the population it is to serve or near some place of common resort, such as the neighborhood store or post office, so that trips thereto may be conveniently combined with other errands. The precise location may be determined by the location of a building which may serve for housing the plant. It will only exceptionally be the case that it will be either necessary or advisable to put up a new building especially for the work, since there are few communities which do not have some building which can be used. A lodge room, school, or hall is usually conveniently located and will have some type of heating apparatus, a water supply, and more or less accessory equipment, such as a range and cooking utensils, or at least chairs and tables, needed for the work. In the absence of such possibilities, a vacant dwelling or store may be rented, or some large outbuilding, such as a granary or tool house, may be pressed into service as a preparation room and shelter for the drier. In every case it should be kept clearly in mind that such drying plants are being constructed primarily as an emergency measure to meet conditions which are more or less temporary and that the expenditures made in such work should be no greater than are absolutely necessary. Consequently, the construction of a new building should be undertaken only as a last resort, after a careful canvass has made it clear that the community has nothing which a comparatively small sum spent in repairs and alterations would make serviceable.

The size and consequent capacity of the drier must be determined from a study of the nature and quantity of the materials to be handled. If the district is one in which there is normally a very large surplus of some one crop, such as berries or peaches, or if it has a variety of highly perishable crops which mature more or less nearly at the same time, the drier must have sufficient capacity to take care of this material rapidly enough to prevent loss by spoilage, even though it has to be operated only at partial capacity before and after the rush season. It is, of course, absolutely essential to the success of any cooperative organization that it be able to serve all its patrons promptly and to prevent the loss of material delivered to it; if the plant be made so small that it becomes swamped under a load of perishable products there is sure to be serious dissatisfaction among the members.

Several types of driers, which vary somewhat in cost of construction but only slightly with respect to efficiency and economy of operation, are described in the pages immediately following. The plans given are purposely generalized, so that the size, and consequently the capacity, of each plant may be adapted to the needs of the particular community

or individual grower. This will present no difficulty to anyone who has had even a limited experience in construction, as the data given will permit ready calculation of the dimensions necessary to provide any capacity desired.

A number of considerations must be taken into account in determining the type of drier to be built in any given case. If the building is only temporarily available and must be used for other purposes after the close of the drying season, the drying unit must be so built that it either can be removed bodily or readily taken down. This restricts the choice of a drier to those types which are complete in themselves and which have self-contained heating devices. On the other hand, if the building is to be available as long as needed for the purpose, the evaporator may, if necessary, be so built that it will become permanently a part of the building. In such a case, the cost of construction may be reduced by using the existing walls and floor as parts of the inclosure of the drier, and if the building has a steam heating system the boiler may be utilized to furnish heat for the drier.

A portable or outdoor evaporator.—The Topping portable or orchard evaporator was designed for use where circumstances demand an inexpensive evaporator of moderate capacity, so built that it can be placed during the working season in any available workroom, or even out of doors, and subsequently removed to any convenient place of storage. This machine, which was first introduced as a small patented device more than forty years ago, has undergone various modifications and improvements and has long since become public property through the expiration of the patents. It has the advantage of extreme simplicity of construction, so that it can be easily built by an ordinary carpenter; it may be built of either wood or metal and can be made any desired size to accommodate 300 to 1,500 pounds of fruits or vegetables at one loading. As usually built, it is provided with a rainproof roof and may consequently be placed in some convenient location in the open beside the workroom, which is especially advantageous when space within the building used as a workroom is at a premium. It may be heated by steam coils when steam is available, by any heating stove of suitable size which is at hand, or by a stone or brick furnace when located in the open. For these reasons the Topping evaporator is deservedly popular among small-fruit growers and is probably more widely used in the Eastern and Central States than any other of the larger home driers.

The general plan of the Topping evaporator is very well shown in figure 9. If it is to be used within a room, it must consist of an upper and a lower section, which are constructed separately for convenience in moving the drier about or may be built together if the drier is to remain permanently in one place. The lower section is the

heating chamber, within which the steam coil or stove is to be placed. It is simply a rectangular box of the same width and length as the drying section above and of such height that the top of the stove used for heating will be at least a foot, preferably 18 inches, below the bottom

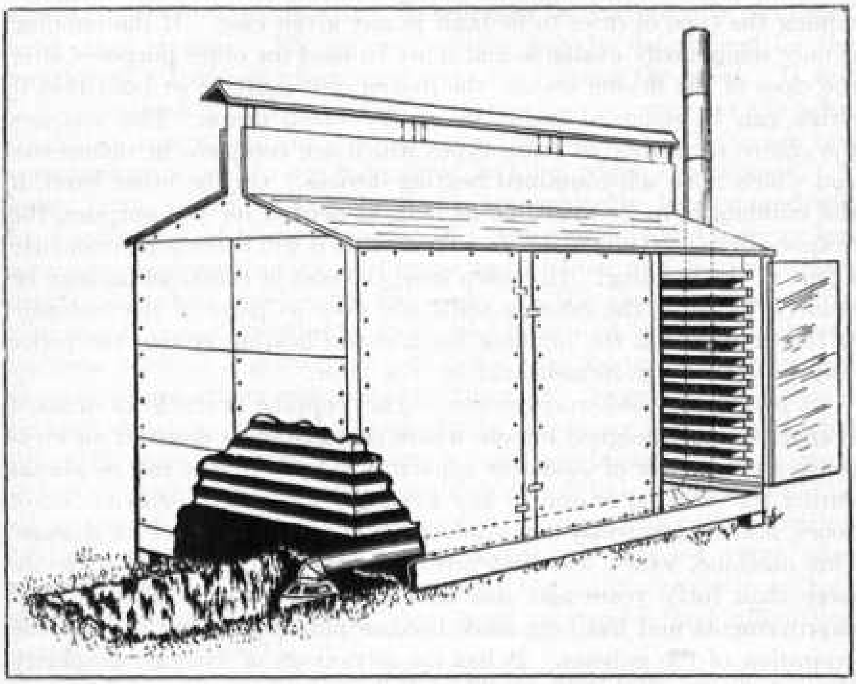

FIG. 9.—A portable outdoor evaporator to be heated by an ordinary heating stove

of the drying section. It is built upon a frame of 2 by 4 inch stuff, strongly braced to support the weight of the drier which rests upon it. The sides and one end are closed with rough lumber, or preferably with sheet iron, in order to reduce the danger of fire. One end has a door the whole width and height of the chamber for use in firing the stove, which is placed just inside this door. From the stove the smoke pipe is carried, suspended by wires, beneath the center of the drier, with a slight upward inclination, to the opposite end, where it passes out and turns vertically upward to join the flue if the drier is to be operated indoors or to be carried several feet above the top of the drier if it is to stand in the open. A number of openings in the walls near the base of this section permit air to enter and become warmed by contact with the stove and heated pipe before rising into the drier above.

If the drier is to stand in the open, a shallow excavation may be made to receive the stove, thus reducing the total height of the apparatus,

or a stone or brick furnace equal in length and width to the size of the drier and covered with a layer of cement to prevent the escape of smoke may be built. If the drier is to be heated by steam, the steam pipe is led in at one end of the heating chamber and carried several times around the inclosure in a series of coils so distributed, one inside the other, that the incoming air may everywhere come in contact with them.

The drying chamber is essentially a boxlike structure provided with a sloping roof which has a simple ventilator throughout its length. The construction of the ventilator and its relation to the roof are so closely shown in figure 9 as not to need detailed discussion. The frame of the drier and the rafters are made of 2 by 4 inch stuff, and the sills of the drier rest directly upon the top of the heating chamber in case the two are built separately. If built in one section the studs are, of course, cut to a length equal to the height which the completed drier is to have.

The drier shown in figure 9 is 10 feet in length, 4 feet 4 inches in width, and 4 feet 6 inches in height to the eaves. The studs are spaced 3 feet 4 inches apart on centers, and the interior of the drier is cut into three compartments by partitions nailed to the studding and extending from the base line to the eaves; these may be either of wood or sheet iron. Cleats made of 1 by 1 or 1 by 2 inch strips are nailed to the side walls of each compartment to serve as supports for the trays and are spaced 4 inches apart from center to center. A 6-inch space is left beneath the lowest cleats in order to increase the distance of the trays from the heater, thus decreasing the danger of scorching the material. The entire front of each compartment is hinged either at the bottom or at one side, to serve as a door for the insertion and removal of trays, while the back and ends of the drier are solidly boarded up.

The width and depth of the compartments are such as to accommodate trays 4 by 3 feet in size, as larger trays would be too heavy for convenient handling when loaded. The height of the drier is made to accommodate 12 trays placed one above another 4 inches apart. This is as large a number of trays as can be employed without seriously slowing down the drying on the upper trays. For this reason no attempt should be made to secure greater capacity by increasing the number of trays in the stack; instead, the length of the drier should be increased so as to give a larger number of compartments: The size of the drier required to care for a given quantity of produce can easily be determined from the following data. If each compartment accommodates a stack of 12 trays, each 3 by 4 feet in size, the compartment will have 144 square feet of drying surface. Each square foot of tray surface will accommodate approximately 1½ pounds of such material as peaches, apricots, cabbage, onions, beans, or sweet corn, which must

be rather thinly spread, or 2 to 2¼ pounds of such products as berries or apples, with which heavier loading is possible. Consequently, each compartment holding twelve 3 by 4 foot trays will accommodate 175 to 200 pounds of products of the first group or 275 to 325 pounds of berries or apples when fully loaded. If the drier is operated continuously, that is, if the fire is kept going steadily day and night and every tray that becomes dry is immediately replaced by a tray of fresh produce, it will be possible to dry two charges of thinly spread trays in 24 hours. If the fires are kept going only during the day and allowed to die down at night the time for drying will be doubled and the capacity of the drier will, of course, be correspondingly reduced.

In operating this drier, as in all others in which the heat is applied to a stack of trays from below, the trays of fresh material are inserted at the top of the stack and gradually shifted downward as they become

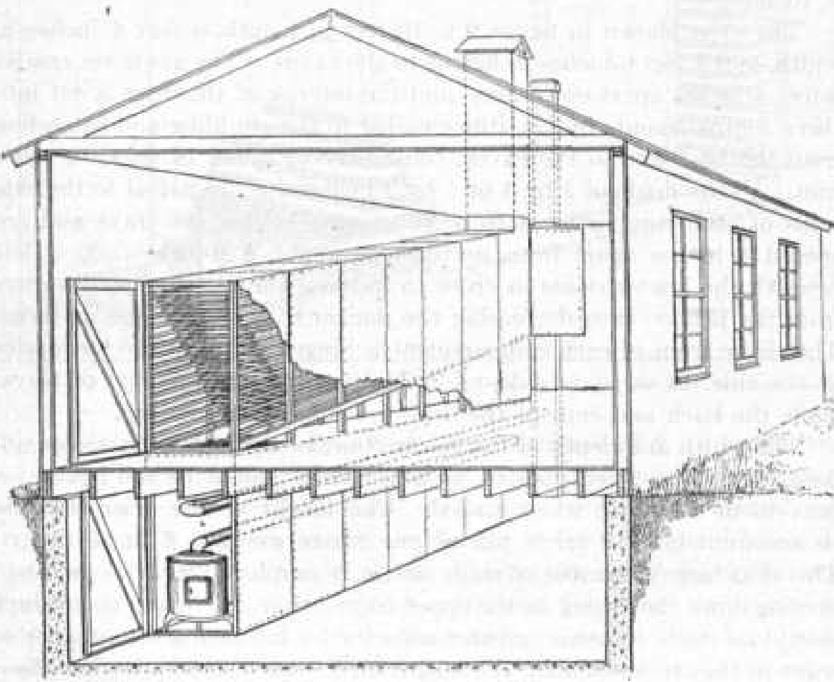

FIG. 10.—A prune tunnel evaporator

dry. The material thus encounters progressively increasing temperatures as it becomes able to endure them without injury; hence, it dries much more quickly than if left undisturbed in one position until dry.

While evaporators of this type are frequently of wooden construction throughout, the use of sheet iron for side walls, partitions, and roof has

the very great advantage that it makes the drier entirely fireproof while adding very little to the cost.

A prune tunnel evaporator.—The type of evaporator which is shown in figure 10 owes its name to the fact that it has been developed in the prune-growing districts of the Pacific Coast primarily for use in curing prunes. While specially adapted to that purpose, its cheapness of construction and operation makes it available for handling any and all products, and it is worthy of much wider use. Its distinctive feature is that its construction secures a high degree of efficiency of the heat employed, as the warm air enters at one end of a long drying chamber and passes over and through the trays to the opposite end before it is allowed to escape. For this reason there is a considerable difference in the temperatures at opposite ends of the drier, and this is advantageous in the handling of most fruits and vegetables, which require a low temperature at the outset but may be exposed to greater heat as they become partially dried.

The prune tunnel drier requires a 2-story building or a single story with a basement for its installation unless steam is employed for heating it, in which case it may be installed in a 1-story building. The drier proper will occupy a position above the floor line, while the heating device is placed in a space below. The prune tunnel is a long, narrow chamber, with floor and ceiling inclined from the horizontal 1½ or 2 inches for each foot of length, thus making one end of the chamber, or tunnel, higher than the other. The warm air inlet is located in the floor at the lower end and the ventilating shaft is placed in the ceiling at the higher end, thus securing a flow of air through both the length and height of the tunnel. Trays containing the material to be dried are inserted through a door at the higher and cooler end and pushed along inclined runways to the lower end, where the drying is completed.

The lower limits of size of a single tunnel may be determined by the capacity required or by the size of the heating unit which is available, but there is a definite upper limit which can not safely be exceeded. A single tunnel should not be made more than 18 or 20 feet in length, 6½ feet in height, and 3 to 4 feet in width. Such a tunnel will accommodate 16 tiers of trays placed 4 inches apart, which will give a total drying surface in a tunnel 20 feet long of 960 square feet if the tunnel is 3 feet wide, or 1,280 square feet if its width be 4 feet. As each square foot of drying surface will accommodate 1½ pounds of thinly spread material or 2 to 2¼ pounds of less delicate products, this will give a capacity of 1,400 to 2,000 pounds of green fruit at a charge for the 3-foot width, or one-third more for the 4-foot drier.

The frame of the tunnel should be made of 2 by 4 inch stuff spaced

not more than 2 feet apart, in order to prevent warping and opening of the walls. For the same reason the walls and ceiling should be of good-quality tongue-and-groove flooring, and should be closely driven together in building. In order to give the ceiling and floor the necessary inclination of 2 inches to the foot of length, the studs at the lower end are cut 6½ feet in length, each successive pair is made 4 inches larger than those immediately preceding them, and all are spiked to the beams that supported the original floor which is taken up over the area occupied by the drier. Pieces of 2 by 4 inch stuff are next nailed to the studding at the proper height, thus forming supports for the floor. In all cases an opening 3 or 4 feet in length and extending across the width of the tunnel is left at the lower end, directly over the furnace, as an inlet for warm air. No special pains need be taken to make the floor tight, and some operators omit the floor entirely, but this practice apparently has nothing to commend it.

Since the upper end of a 20-foot tunnel is 3 feet 4 inches higher than the lower end, it is necessary to surround the upper end with an inclined false floor leading up to the doors, in order to permit easy access with trays loaded with fruit.

If a single tunnel is being built the sheathing of the side walls should be nailed to the inner surface of the studding, thus giving a smooth surface upon which cleats for carrying the trays may be nailed, leaving no spaces at the sides through which air may pass directly up. When two or more tunnels are built side by side the common walls should be boarded on both sides, for the same reason.

The ventilating shaft extends entirely across the upper end of the tunnel and should be not less than 2 feet in width. It should be carried to a height of 3 or 4 feet above the roof of the building, in order to secure a good draft.

The doors of the tunnel must, of course, open for the entire width and height and should be carefully fitted and provided with closing strips and a tight latch, so that air currents may not enter through them. If the tunnel is more than 3 feet wide double doors meeting at the center of the opening will be more convenient than a wide single door.

The cleats carrying the trays are nailed directly to the side walls of the tunnel, with the same inclination as the floor and ceiling. The first pair of cleats are placed with their upper edges 6 inches above the floor line, and those above are spaced 4 inches apart from center to center. The cleats may be 1 or 2 inches wide, but should be a full inch in thickness in order to give a broad supporting surface for the edges of the trays, and great care must be used in selecting and placing them so that the upper edges form straight lines, as otherwise there will be difficulty in sliding trays along them.

In use, the trays of fresh material are always inserted at the upper end, where they are allowed to remain from 1 to 3 hours. Each is then pushed down far enough to permit the insertion of a tray behind it, and this is continued at intervals until the runways are filled. A tunnel in operation consequently always has at the lower end trays of material which is nearly dry and which is receiving the full heat of the furnace, while behind these are successive tiers of trays each filled with material containing more water and surrounded by air of lower temperature and higher moisture content, the last tiers being filled with freshly prepared material which has not yet begun to dry and which is being slowly warmed up by currents of relatively moist air at moderate temperature. The advantages are obvious. The arrangement permits the insertion of new trays as rapidly as they are prepared, and the overheating and injury of water-filled fruit are avoided, while the material is automatically moved forward into higher temperatures as rapidly as it becomes able to withstand them.

When the tunnel is completely filled there is a very strong tendency for the heated air to travel between the lower trays, resulting in slower drying in those near the top of the drier and necessitating much labor in shifting the trays. In order to remedy this, it is a good plan to omit one tray from each runway and so to arrange the trays at the lower end of the tunnel that the edge of the lowest tray in the stack is just flush with the edge of the hot-air opening in the floor, the next projects 2 or 3 inches beyond the first, and each succeeding tray stands out for the same distance above its fellow immediately below. The edges of the trays thus act as a series of baffle plates, breaking up the ascending current of warm air and distributing it through the stack in such fashion that trays at the top and bottom dry at equal rates and the laborious shifting by hand of trays from the upper to the lower runways is entirely avoided.

Two dependable thermometers should be present in the drier at all times, one at the upper and one near the lower end, and the person in charge of the furnace should so regulate the firing that the temperature at the upper end shows no sharp variations from that recommended for the particular material being handled when fresh, while that at the lower end is within the range permissible for finishing the drying.

A single tunnel 20 feet or less in length can be very satisfactorily heated with any stove which would be large enough to heat comfortably an ordinary 20 by 20 foot living room. If more than one tunnel is to be heated, a larger heating stove or a furnace of the type used in commercial drying plants should be secured. In such plants the tunnels are usually built in groups of three, the furnace is placed beneath the floor opening of the central tunnel, and the pipe is divided by a T-joint

into two lines which are carried out beneath the openings of the lateral tunnels and then brought once or twice around the furnace room before passing into the flue.

The furnace may burn either wood or coal, but both stove and pipe should be tight and in good repair, so that there will be no escape of soot and smoke, which would necessarily rise through the fruit above. The stove is placed directly beneath the opening in the floor of the tunnel at its lower end, and the pipe is brought up to within 3 feet of the floor and then carried at about that distance from the floor of the tunnel but with a slight upward inclination to the upper end, where it enters the chimney. Since there must be free access to the end of the tunnel, the chimney must stand at one side, or the pipe may be carried beneath the floor of the basement to a conveniently located flue, provided that an upward inclination be maintained to prevent sooting up.

The furnace room may be an inclosure of the same or slightly greater width than the tunnel above it, but it should be at least 2 feet longer, this additional length being located at the lower end, in order to permit the placing of the furnace immediately beneath the opening in the floor above. If the tunnel be placed against the side wall of an existing building, the furnace room may be made by erecting partitions covered with rough boards or sheet iron to complete the inclosure, with a door for access in firing the furnace. Ventilator openings 1 foot in height and 3 to 5 feet in length should be left in each of the side walls at their middle point and just above the ground level, in order that the incoming cold air may pass over the heated furnace and piping before passing into the tunnel.

Driers employing steam heat.—When the building in which the drier is installed has a steam heating plant or when a canning plant equipped with a good-sized boiler is operated in connection with the drier, the latter may be heated by steam. The advantages are several. The entire outfit may be installed upon one floor without disturbing existing walls or floors, there is no dust or smoke, and the temperatures employed are under the control of the operator, yet may be modified quickly and at will to suit the various products being handled. There is a considerably increased first cost over a furnace-heated drier of the same capacity, due to the cost of steam coils and plumbing, but if waste steam from a boiler is available the saving of fuel will offset this to a considerable extent, particularly if the plant has a good variety of material and consequently a fairly long working season.

A steam-heated tunnel drier.—The tunnel evaporator described in the pages immediately preceding can readily be adapted to heating with steam, and the steam-heated tunnel can be installed without disturbing

the existing floor in any room which has a fairly high ceiling. In order to do this the lengths of the studding of the tunnel are increased 18 inches, so that the warm air inlet at the lower end of the tunnel is 18 inches above the floor level. The heating coils are placed in this space and may consist of a number of flat coils of 1 or 1½ inch steam pipe, placed one above another; or a very effective heater may be made of two or three ordinary radiators, laid upon their sides, one upon another, and connected in series. The heating unit is boxed in by board walls containing good-sized ventilator openings screened to prevent the entrance of dust. As it will be necessary to build a false floor around the tunnel to permit easy access in inserting and removing trays, air ducts leading beneath this false floor from the ventilator openings to inlets in the outer walls of the building may easily be built. Or, if the drier stands in a second-story room or over a basement, the floor beneath the air inlet may be taken up, the steam coils placed over the opening, and the sides tightly boxed in, so that air enters only from the room below the drier, thus keeping out the dust which would otherwise come in from the floor of the workroom.

A steam-heated cabinet drier.—A type of cabinet, or "box," drier which is heated by steam has recently come into use, particularly in New York and adjacent Canadian territory, in the drying of fruits and more particularly of vegetables destined for use by the Allied armies. The initial cost of piping and installation makes the total investment much greater than that required to build a furnace-heated drier of equal capacity; but the heating coils are built of ordinary iron pipe, and the drier may be of any desired size, is self-contained and portable, can be set up in any location where steam is available, and is so compact that it gives large capacity in proportion to the space required. There are, of course, no restrictions upon the character of the boiler or the sort of fuel employed in supplying steam.

As usually constructed, the cabinet drier is a rectangular chamber 18 feet long, 7 feet wide, and 10 feet in height, outside dimensions. It is heated by rows of steam pipes fed from a common header, the header being located at one end of the drier and 6 feet from the floor. From it twenty-four 1-inch steam pipes are led to the opposite end of the drier, where they are dropped 8 inches by means of elbows and unions and led back to the other end, again dropped and carried to the opposite end, each pipe passing through the length of the drier six times before it empties into a return pipe, which carries the condensed water back to the boiler. Each row of pipes is given 1 inch of fall for each 6 feet of length, thus securing a good circulation. The spaces between the successive banks of pipe are consequently 8 inches wide at one end, and this distance increases to 14 inches at the other. The heating pipes are carried upon

a framework of similar pipe, as is shown in figure 11, in such fashion as to be entirely independent of the outer walls of the drier and the supports for the trays.

The framework of the cabinet surrounding the drier is built of 2 by 4 inch stuff. As the trays used are 4 by 3 feet in size, the studs at one side of the drier are spaced 4 feet 4 inches apart on centers to admit the trays which are inserted between them. These studs are to carry cleats for supporting the trays. On the opposite side, which is to be boarded solidly, additional studding may be placed midway between those which carry the trays. The ends of the cabinet may be built in removable sections, fastened in place by buttons, but it is better to make them a series of hinged doors, for the sake of easy access to the pipes when repairs are necessary.

As any two coils of pipe are 8 inches apart at one end of the drier

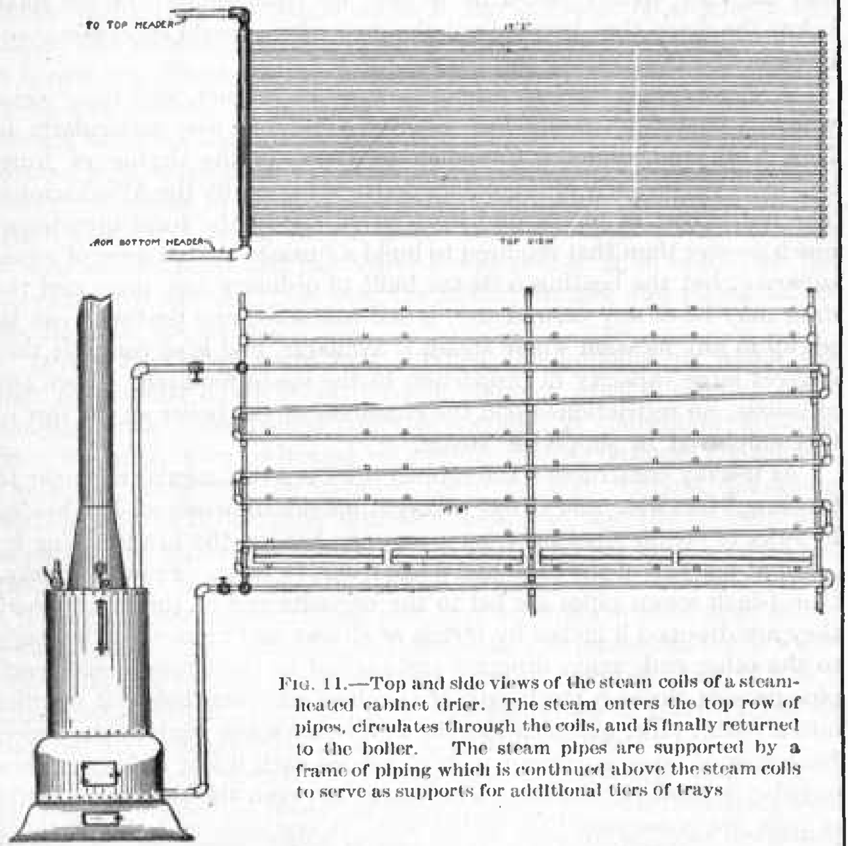

FIG. 11.—Top and side views of the steam coils of a steam-heated cabinet drier. The steam enters the top row of pipes, circulates through the coils, and is finally returned to the boiler. The steam pipes are supported by a frame of piping which is continued above the steam coils to serve as supports for additional tiers of trays

and 14 inches at the other, the number and spacing of the cleats which are to form runways for the trays are determined by this fact. The cleats supporting the trays should be 3 inches apart from center to center and there should be a space of at least 1 inch between a tray and the pipes above or below it. Consequently, the wider spaces between coils will admit three trays; the narrower ones, only two. The cleats should be well-seasoned 1 by 2 inch strips of some non-resinous wood which does not readily warp and split under heat, and

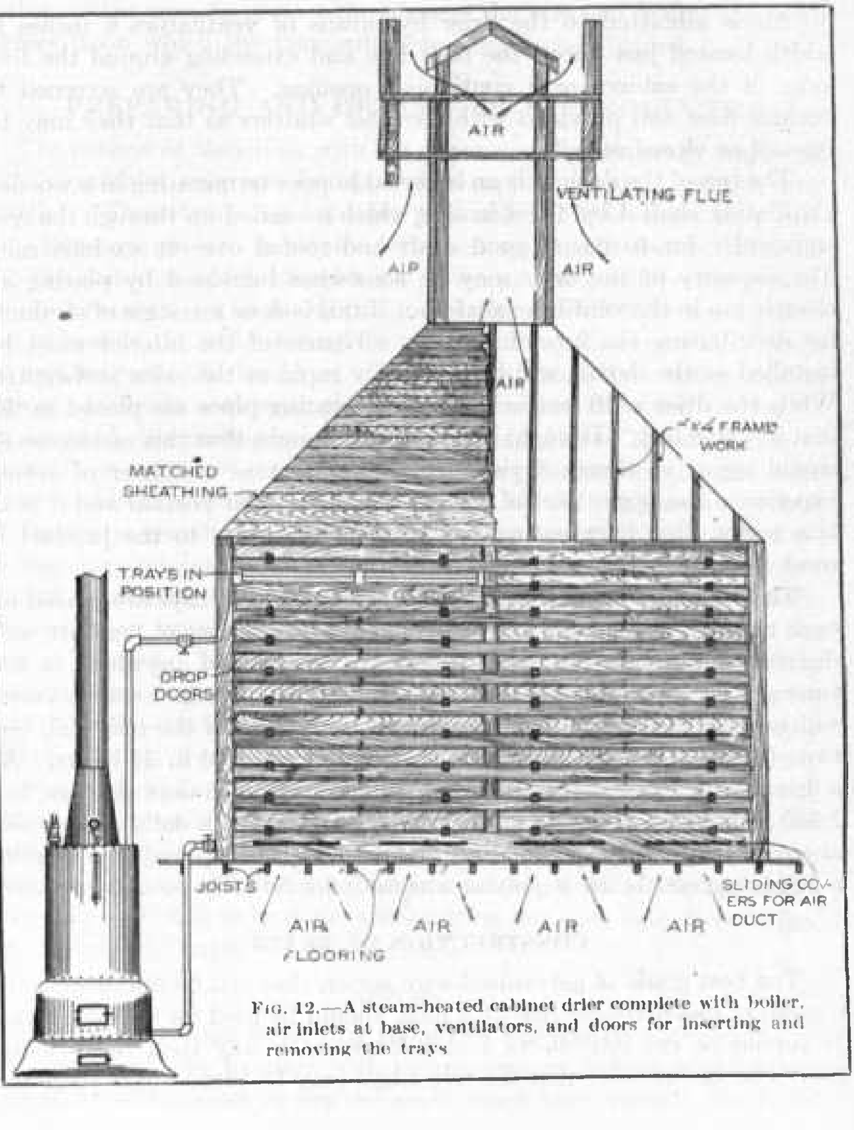

Fig. 12.—A steam-heated cabinet drier complete with boiler, air inlets at base, ventilators, and doors for inserting and removing the trays

the upper surface of each should be planed smooth before it is put into place, in order that the trays will slide readily over it. The front or open side of the drier is made up of a series of doors, each hinged at the lower edge so that it opens downward. These doors are made 22 inches wide, so that each gives access to the trays between two tiers of piping. Pieces of 2 by 4 inch stuff spiked horizontally to the upright studding complete the framing of the doors, each forming a check against which the door below closes and a support to which the door above is hung.

Air is admitted to the drier by means of ventilators 6 inches in width located just above the floor line and extending around the four sides of the cabinet as a continuous opening. They are screened to exclude dust and provided with movable shutters so that they may be opened or closed at will.

The top of the cabinet is an inverted hopper terminating in a wooden ventilating shaft 4 by 4 feet in size, which is carried up through the roof sufficiently far to insure good draft and roofed over to exclude rain. The capacity of the drier may be somewhat increased by placing an electric fan in the ventilator shaft, but if this is done a system of air ducts for distributing the incoming air to all parts of the interior must be installed or the drying will be unequally rapid at the sides and center. While the drier is 10 feet in height, the heating pipes are placed in the first 5½ to 6 feet. It might seem at first thought that this arrangement would result in slower drying at the top, but as a matter of actual experience the upper part of the drier is the hottest portion and it is in this region that overheating and consequent injury to the product is most likely to occur.

The trays are made 3 by 4 feet in size, and two trays are placed on each runway, one behind the other. Since the sources of heat are well distributed through the drier, trays may be inserted anywhere as the runways become empty. The time required for drying of course varies widely with the depth of spreading and the nature of the material, but two charges of thinly spread material should be dried in 24 hours. As a drier 18 by 7 feet in size and 10 feet high, having 16 tiers of trays, has 2,300 square feet of drying surface, this would give it a daily capacity of about 6,500 pounds. To operate the drier at this capacity will require a 20-horsepower boiler supplying steam under 50 to 70 pounds pressure.

CONSTRUCTION OF TRAYS

The best grade of galvanized-wire screen that can be obtained, with a mesh of one-fourth or one-fifth inch, should be used for making trays. It should be cut into pieces 1 inch larger each way than the finished tray is to be, in order that the free edges may be turned over to give a

firmer attachment to the frame. A shallower reversible tray is made by using 1 by 1 inch strips. The wire is tacked to a frame made of these; the tray is then turned over and a second set of strips nailed to the first, making a tray which may be used either side up. To make deep trays for such products as apples or cabbage, 1 by 2 inch strips are used for the frame and the wire is fastened with staples to the edges of the strips. In order to prevent the loosening of the wire from the frame, strips of hardwood one-half inch in thickness should be nailed upon the bottom of the tray, to protect the edges of the wire and to give a smooth surface upon which the tray will slide easily when loaded.

PREPARING AND DRYING FRUIT PRODUCTS

The process of blanching with hot water or steam generally employed with vegetables can not be applied to apples, pears, apricots, and peaches. These fruits are valuable primarily for the sugars they contain; these are present in soluble form and are in part lost by diffusion into the water in which blanching is done, and in considerably greater amounts escape later in the dripping of juice which follows the application of heat to the scalded or steamed fruit. For this reason such fruits are treated with the fumes of sulphur for a short time before drying begins. In fruits so treated, the chemical changes discussed on page 8 are arrested, the discoloration and blackening due to the oxidation of tannin does not occur, and the dried product has practically the color of the freshly exposed flesh of the fruit from which it was made. While sulphuring is sometimes called bleaching, the use of this term is misleading, since sulphur fumes do not bleach or whiten the fruit, but merely prevent darkening after the treatment. As the purchasing public demands such fruit, the entire commercial output for many years has been so treated. Unsulphured fruit will darken to an extent directly dependent upon the time required in drying and is subject to souring and to insect attacks in drying, while sulphured fruit is not. There is neither gain nor loss in palatability or in food value as a result of sulphuring, and while the practice has been subjected to severe criticism it has never been shown that it is injurious to persons consuming the products. Consequently, the decision as to whether fruits dried for home use shall be sulphured or not is a matter to be left to individual preference. If it is to be done, a sulphuring box such as is described on page 14 must be made for the purpose.

APPLES.

The fruit intended for drying should be reasonably mature but not soft, and should be handled with proper care in picking and hauling so as to avoid bruising, as bruised spots which have become discolored

must be trimmed out in order to make a good-looking product. In preparing apples the working force must be so divided that the fruit is trimmed and sliced as rapidly as it is pared, as peeled fruit must not be allowed to remain standing in the air while awaiting its turn at the hands of the trimmers and slicers. After paring and coring, the apples should be trimmed immediately, to remove all bits of peel, discolored or decayed spots, and fragments of core, and at once sliced. Apples are usually cut by means of an attachment on the parer or by a special slicing machine into slices or rings at right angles to the core hole and one-fourth inch thick, but a few individuals will prefer to cut them into quarters. Quartered apples by reason of their greater thickness and the varying size of the pieces, dry more slowly and unevenly than slices and hence reduce the daily capacity of the drier and require a greater expenditure of fuel per dry pound, for which reasons they are now rarely made in a commercial way.

If the fruit is to be sulphured, it should be spread upon the trays to a uniform depth of 1 to 1½ inches as rapidly as it is sliced and immediately placed in the sulphuring box for 20 to 30 minutes, after which it is transferred to the evaporator. If it is not to be sulphured, darkening can be prevented only by providing pails of water into which the fruit is dropped after paring. Trimmers and slicers are also provided with such pails, so that the fruit is exposed to the air only while actually being handled by the workers until it is spread on trays and placed in the warm evaporator. Drying is begun at 130° F. and the temperature gradually increased to 175°. The trays of drying apples should be examined from time to time and, if necessary, stirred with the fingers to correct any tendency to unevenness in drying. The fruit is sufficiently dry when a handful of slices gripped firmly in the hand has an elastic, springy feel, separates promptly when the pressure is released, and leaves no visible moisture upon the hand. It should be removed when this condition is attained and before the slices become crisp and hard, and subsequently treated as described in the section on "Treatment of products after drying," page 56.

PEARS

The drying of pears in a commercial way is practically confined to California, and the methods of handling there used may be followed in a general way. Pears intended for drying are picked when the fruit is still quite firm but is readily loosened from the tree when slightly lifted with the hand. They are then stored in boxes or crates beneath a shed for a week or more until ripe but still firm. They are prepared for drying by removing stem and calyx, splitting lengthwise into halves without removing either core or peel, and spreading on trays in a single layer, cut surface uppermost. In order to make a product having an

attractive appearance it is necessary to continue the sulphur treatment for three or four hours, or even a longer time. If the fruit is not sulphured it is necessary to keep it under water after cutting, in the fashion described for apples, until it can be spread and placed in the drier. Half pears dry more slowly than apples and, if preferred, the fruit may be peeled and cored and cut into quarters or eighths, which will facilitate drying and also reduce the time necessary for sulphuring. The temperatures to be employed in drying are those recommended for apples. The properly dried product is elastic and rubberlike, and it is impossible to press water out of the freshly cut surface of the pieces. The treatment after drying is identical with that given apples.

PEACHES

Peeled evaporated peaches are comparatively unknown in the markets, practically all commercially dried peaches being dried without peeling. For home use the fruit may be pared by hand, or preferably by a hot lye bath, as described on page 14, as no entirely satisfactory machine for peeling peaches has as yet been placed on the market. After paring and subsequent washing the fruits are cut in half, the stones removed, and the halves immediately spread in a single layer, with the stone cavity uppermost, upon the trays. If the fruit is pared, sulphuring for 20 to 25 minutes will be sufficient; if unpared the time must be increased to 1 or 2 hours. These periods can not be considered as definitely fixed, however, as the time needed will vary with the degree of maturity of the fruit used, and even more widely with varieties, a variety of high water content, open texture, and soft flesh, such as the Elberta, requiring little more than half the time needed for such firm, dry-fleshed varieties as the Lovell and Muir. The sulphuring is completed when juice begins to collect in the stone cavity. This necessitates careful handling in transferring the fruit from the sulphuring box to the drier, as this juice is rich in sugar and must not be lost by carelessly tipping the trays. Great differences will be observed in the time required for drying. The criterion for sufficiently dried fruit is the attainment of the pliable, leathery character described for apples.

APRICOTS

The fruit intended for drying should be picked from the tree before it becomes ripe enough to drop. The handling of apricots in preparation for drying is like that given peaches, as outlined above, with the difference that the fruit is never peeled but is halved, stoned, and sulphured for 1½ to 2 hours. In apricots, as in peaches, a rich sirup collects in the stone cavities after sulphuring, and careful handling to

avoid its loss in transferring to the drier is necessary. With both apricots and peaches drying should be begun at a temperature of 130° to 145° and gradually increased to 165° F. toward the end of the drying process.

CHERRIES

Sweet cherries make a very acceptable product when dried and may be employed in the same ways and for the same purposes as raisins. The sour or pie cherries are also easily dried. The fruit is washed, picked over to remove stems and imperfect fruits, and then spread in a single layer on the trays and placed in the drier without sulphuring. If the fruits are very large they may be pitted before drying, but very large quantities of the juice, which contains a considerable portion of the sugar of the fruit, are lost in the process. If this juice, which amounts to 35 to 50 gallons per ton of fruit, can be saved and combined with apple or other juices in the making of jellies, pitting may be attempted; otherwise the process is both time-consuming and wasteful. The drier should not be hotter than 120° F. when fresh cherries are placed in it, and the temperature should never rise above 150°, as cherries especially are easily injured by overheating.

PRUNES

Prunes intended for drying should be allowed to become fully ripe and fall from the trees of their own accord, as such tree-ripened fruit is considerably richer in sugar than that obtained by shaking the trees. Three or four pickings will usually suffice to gather the crop. The fruit should be gathered into crates or boxes holding not more than a bushel and should not be allowed to stand in the crates more than 12 hours after it reaches the drier. In gathering, all partially decayed, overripe, fermenting, or soft fruit should be discarded.

The term "prune" is applied to several varieties of plums which are alike in that they may be successfully dried without the previous removal of the stones, but which differ in other respects. All those varieties which are commonly dried require a short immersion in boiling lye to remove the thick waxy coating and to check or crack the skin and permit the contained moisture to escape. The exact time for dipping will vary with the variety and also with the degree of maturity of the fruit, but will be about 35 to 45 seconds for immature fruit and not more than half that time for that which is fully ripe. The dipping is properly done when the fruit shows a few very fine checks over the surface and particularly near the point of attachment of the stem, but must not be continued until the skin is actually split or begins to peel off. The lye should be boiling, and the dipping basket should be moved

about in the liquid to aid in bringing all the fruit into contact with the solution. The basket should then be quickly transferred to a large vessel of cold water and thoroughly rinsed to remove the lye, after which the fruit is spread in a single layer upon the trays. With the dark-fleshed prunes, such as the Italian or Fellenburg and the Prune d'Agen (also known as the Petite or French prune), which, with the Imperial prune, constitute the principal varieties used for drying, no further treatment is given. Light-fleshed varieties, such as the Silver prune or Golden Drop, require a short treatment in the sulphuring box immediately after the lye dip, in order to preserve the color. Prunes are sufficiently dry when the flesh shows no moisture when torn across and pressed vigorously between the fingers.

It is possible to dry other varieties of plums quite successfully by cutting the fruit into halves, removing the stones, and placing the fruits in trays in a single layer, stone cavities uppermost. Lye dipping is unnecessary with plums, but a short treatment with sulphur fumes, 20 to 25 minutes, will be required to preserve the color. The treatment of plums cut into halves is that given apricots and peaches, and the criteria for determining when the fruit is sufficiently dried are the same. By reason of their thick, waterproof skins, prunes are especially liable to be burst by overheating at the beginning of drying. Consequently, fresh trays should always be placed in the coolest portion of the evaporator, and the temperature should never be allowed to exceed 140° F., and should preferably be 10 degrees lower for the first 3 or 4 hours. As wrinkling of the surface begins, the temperature may be gradually increased and may rise to 175° F. without danger of injury as the fruit becomes nearly dry.

FIGS

Dried figs are practically unknown outside of California, where the Mission or California Black, the Calimyrna, and the White Adriatic varieties are dried in a small way for local use. Any of the varieties grown in the Southern States make a delicious product when properly dried. The White Adriatic requires sulphuring to preserve the color, but this is not necessary with the other varieties.

The fruits are picked when fully ripe, or may be allowed to fall from the trees. They are picked over to remove any decaying fruits, washed, and spread upon the trays, preferably in a single layer. The drying should be started at 120°, and should at no time be allowed to rise above 140° F. When the fruits are nearly dry they should be dipped for two or three minutes in a boiling brine solution made by dissolving 1 pound of common salt in 3 gallons of water. The figs are then drained and returned to the trays, and the drying is completed. This brine dip is

given primarily because it makes the skins soft and glossy, but it doubtless is also more or less effective as a sterilizing agent.

BERRIES

Blackberries, raspberries, and loganberries receive identical treatment in preparation for drying; hence they need not be separately discussed. Dewberries, huckleberries, blueberries, and gooseberries are occasionally dried, the method of treatment being that here outlined. Any of the cultivated blackberries, as well as the wild varieties, make excellent dried fruit. Among the raspberries the black varieties, such as the Ohio and Gregg, are prime favorites with commercial evaporators because their firmness permits spreading them rather deeply on the trays, while they also dry more quickly and give higher yields of the dry product than softer varieties. These last can be successfully dried, however, provided care is taken not to allow them to become overripe and soft before picking. There is little commercial demand for dried red raspberries, which dry more slowly, are much more liable to crush and mat on the trays in drying, and give a lower yield of more sharply acid fruit than the black varieties; but they may be dried for home use in the same way as other berries. Loganberries demand particularly careful handling, as they become very soft when first heated and are especially prone to flatten out, mat together, and lose juice by dripping in the drier. They must be spread in thinner layers than other berries, and the temperature of the drier should not be allowed to exceed 130° F. at the beginning of drying, but may be gradually advanced to 145° or 150° toward the close.

Berries which are to be dried should be picked in the early morning hours, so that they may be brought under cover before becoming heated by the sun. The vines should be picked over frequently, so that only firm, market-ripe berries are brought to the drier, and the pickers should be supplied with shallow picking vessels and instructed to avoid crushing the berries in picking and handling. Pouring the berries from one vessel to another and stacking filled boxes so that one box rests upon the fruit in another are especially to be guarded against. All berries brought in on any one day should be placed in the evaporator before the end of that day, as crushing and leakage with the resulting multiplication of organisms causing spoilage will occur if the fruit is allowed to stand over night. If delays in starting the drying are absolutely unavoidable, the fruit should be placed in the coolest possible place of storage until it can be accommodated in the drier. Berries should be spread uniformly upon the trays to a depth varying with the ripeness and physical character of the fruit, the softer berries in a layer not more than two berries deep. A little practice will enable one to spread berries quite

uniformly by careful pouring from the vessels. Smoothing with the fingers and attempts to pick out leaves, bits of stem, and green berries are to be avoided, as these are readily removed after the berries are dry by passing the fruit over a screen. The trays should be placed in the evaporator as rapidly as they are filled. An initial temperature of 135° to 145° F., gradually increased to 150° to 155°, when the fruit is two-thirds to three-fourths dry, may be used with blackberries, raspberries, and any other berries except loganberries and red raspberries, which should be started at 130° F. When the berries have dried sufficiently to be stirred without crushing, the trays should be gone over and any thick clumps which are drying too slowly spread out with the fingers. The fruit is dry when it begins to rattle somewhat on the trays and when the berries no longer show moisture when crushed between the fingers.

While it is possible to dry gooseberries, currants, strawberries, and a variety of other small fruits, attempts to do so are inadvisable. Currants and gooseberries have such a wide range of usefulness that it is unnecessary to dry them in order to avoid allowing them to go to waste. The distinctive coloring and flavoring substances of strawberries are readily driven off or broken down by heating, and as the fruit is extremely high in water content and soft in texture, it is extremely difficult to dry without loss by dripping. For these reasons the dried product is usually so effectively denatured as to have little of the appearance, color, or flavor of the fresh fruit, and is to be regarded as a curiosity rather than a valuable food material. It is desirable to restrict the work of drying to those perishable materials which are staple food products and to conserve only such accessory fruits of small value and minor importance as are not used in the fresh condition in other ways.

PREPARING AND DRYING VEGETABLE PRODUCTS

The generally available information in regard to the drying of vegetables is mainly confined to methods of handling potatoes, turnips, carrots, beets, parsnips, onions, and cabbage. These are the vegetables which commercial evaporators in the United States and Canada have had experience in handling, since they constitute the list of vegetable materials needed in the rationing of the Allied armies. The primary reason for drying them, of course, lies in the fact that they are so bulky that transportation over long distances is quite impracticable; drying removes all nonedible portions and produces great reductions in weight and bulk while at the same time it permits storage for an indefinite period without danger of deterioration.

The vegetables just listed, however, are the least rapidly perishable

of our staple vegetable foodstuffs. In practically every part of the United States it is possible to store some or all of them outdoors in pits in the ground or in any ordinary cellar through the winter, thus assuring a constant supply of fresh vegetables at the expense of very little time and trouble. Wherever such pit or cellar storage is possible any labor spent in drying potatoes and other root vegetables, onions, and cabbage will be wasted. In districts that have no near-by sources of supply of staple vegetables there is usually a short period in which these products are plentiful in the markets, and wherever possible at such times supplies should be stored for winter use, either outdoors in pits roofed with boards and protected by banks of earth or in a portion of the basement or cellar partitioned off for the purpose. The drying of these vegetables for family use should be undertaken only as a last resort, and in households which are so situated that storage in quantity in the fresh condition is impossible, as is, of course, the case in a large percentage of city homes.

Drying is not a means of utilizing vegetables which are not good enough to can or use fresh. It can not improve the quality of any material; it can at most merely preserve it without deterioration. In consequence, there are a number of indispensable prerequisites to the making of a high-class dried product. Such material as deteriorates rapidly after gathering must be gotten to the drying plant without delay; it is impossible to make good dried products from vegetables which have been overheated and wilted in transit or upon hucksters' stalls and which have consequently begun to undergo destructive chemical changes. For first-class products the raw material must come fresh and crisp from the field, must undergo rigid examination for the removal of all diseased or overripe and decaying portions, and must be treated throughout its preparation for the drier in exact accordance with directions. Any material which you would not use for canning or readily accept for cooking and serving on your table will not make an acceptable dried product.

Practically all vegetables, after being sliced or otherwise made ready for the drier, undergo blanching. It is just here that the final quality of the product is largely determined, since the best material will be spoiled by careless or improper blanching. The word blanching is a canner's term and is applied to a brief treatment of the material with boiling water or steam. The equipment used is described elsewhere (page 13). The purposes of the treatment are several. It stops destructive chemical changes by destroying the agents which produce them and consequently prevents darkening or discoloration, it preserves or "sets" the natural color, it coagulates some of the soluble constituents, and it kills the protoplasm and consequently accelerates the escape of moisture in drying. Blanching must not be confused with cooking; it in no sense

takes the place of the subsequent cooking in preparation for the table. If too long continued it does harm by dissolving out some of the valuable constituents, by breaking down the pigments which give color to the material, or by converting the starch present into a partially cooked paste. For these reasons blanching, whether accomplished by dipping into hot water or by exposure to steam, must be carefully and intelligently done.

POTATOES

Potatoes must first be thoroughly washed to remove dirt and stones. If they are to be peeled in one of the rotary peelers they should be roughly graded for size, as the percentage of waste is greatly increased when potatoes of different sizes are placed together in the machine. Whether the paring is done by machine or by hand, the operators must be cautioned against removing a needlessly thick peel, as the layer immediately beneath the outer skin of the potato contains a considerable percentage of valuable nitrogenous material which is lost by deep paring. When machines are used the eyes must be removed by hand and the workers at the same time must remove all bits of peel and diseased or discolored portions. If the women entrusted with this tedious work can not keep up with the parer, the tubers must be dropped into cold water immediately after paring. Slicing may be done either with a rotary slicer, an apple slicer (such as is shown in figure 5), or by hand, but in any case the slices should be uniform in thickness to insure even drying. Three-sixteenths to one-fourth inch is the best thickness. As rapidly as the potatoes are sliced they must be dipped or steamed. If to be dipped they are placed in a wire-bottomed basket or box to a depth of not more than 4 or 5 inches and plunged into the water, which should be 8 or 9 inches deep and should be boiling so vigorously as to stir and separate the slices. They should remain in the water 2 or 3 minutes, and should then be withdrawn, drained, spread upon the trays to a depth of about an inch, and immediately placed in the drier. If steaming is the process employed, the trays are spread directly from the slicer and placed in the steamer. The steam box must be left open after the steam has been turned on until the air is displaced as completely as possible. The door is then tightly closed and the potatoes allowed to remain 1 to 3 minutes. The exact time necessary for either steaming or dipping will vary with the season, the variety of potato, the thickness of the slices and the depth to which the trays are loaded, and the efficiency of the steaming box; hence, it must be determined by experiment. The purpose in view is the prevention of darkening, and the treatment should be continued no longer than is absolutely necessary to accomplish this, as prolonged treatment partially cooks the potato

and makes it less like fresh potato when subsequently cooked. The drying should be begun at 125° F. and the temperature gradually increased as drying proceeds, finishing with a temperature of 145° to 150°. Potatoes are sufficiently dried when they rattle sharply when stirred with the hand and when the pieces no longer show opaque, spongy white areas here and there on their surfaces. They are treated after removal from the drier in the manner described in the section on "Treatment of products after drying," page 56.

TURNIPS

Turnips intended for drying should be gathered before pithiness begins to appear. They are treated precisely like potatoes in so far as washing, paring, slicing, removal of diseased or discolored portions, and spreading on trays are concerned. They require a somewhat shorter treatment with steam or hot water than potatoes, and slightly higher temperatures may be used in drying, 135° to 140° F. at the outset and 160° to 165° toward the end being perfectly safe.

BEETS, PARSNIPS, AND CARROTS

Beets, parsnips, and carrots should receive the same general treatment given potatoes. They may be pared in the same way, or preferably merely scraped sufficiently to remove the outer dark layer, and are sliced the same thickness. If preferred, any of these vegetables may, of course, be cut into strips by cutting across the slices. A very short treatment in boiling water or steam, not more than two minutes in duration, preserves the natural color, which will change to a grayish or yellowish brown during drying if the product is dried without blanching. The drying should be begun at 120° F., and the temperature should not be allowed to rise above 145° at any time. Parsnips, carrots, or beets are sufficiently dry when the pieces break when one attempts to bend them and when they show no moisture upon being pressed between the fingers. See "Treatment of products after drying" for methods of caring for the dry products.

CABBAGE

Cabbage is prepared for drying by trimming off all dead, diseased, or discolored leaves, cutting out the central stalks, and cutting the heads into slices one-third to five-eighths inch thick, which are subdivided by again slicing at right angles to the first cut. A rotary slicer of sufficient size to receive a half head of cabbage will do the work rapidly and satisfactorily, but an ordinary slaw cutter, or even a butcher knife, may be used. The sliced cabbage is blanched by exposing to steam for

three minutes after spreading on the trays or by dipping into boiling water in a wire-bottomed box or basket for four minutes. The dipping vessel should not be filled to a depth of more than 6 to 8 inches and the contents should be stirred vigorously during the dipping, in order that the hot water may quickly reach all parts of the vessel. Since cabbage tends to pack together rather closely on the trays, care must be taken to spread it as evenly as possible to a depth of not more than 1 inch and to stir the material frequently in the earlier hours of drying, in order that thick masses may be spread out over the thinner areas. Start the drying at 115° to 125° F. and increase the temperature by 10 degrees as drying nears completion. Great care must be taken to avoid scorching the product; the thin portions of the leaves dry much more quickly than the thick, fleshy ribs, and are very prone to scorch and brown upon the slightest overheating. The product is sufficiently dry when no water can be squeezed out of the thicker pieces by strong pressure between the fingers.

CAULIFLOWER

Remove diseased or discolored portions of cauliflower, wash, and cut into small pieces, either by hand or preferably in the rotary slicer. Blanch five or six minutes in steam or four minutes in boiling water. Spread rather thinly on the trays and dry with an initial temperature of 120° F., which may be increased, if desired, to 130° as the material becomes almost dry. Cauliflower undergoes a very considerable darkening during drying, despite the rather prolonged period of blanching here recommended, but the original color is more or less perfectly regained when the dried material is subsequently soaked and cooked. It is treated in the curing room as are other vegetables and is sufficiently dried when no moisture can be crushed out of the pieces with the fingers.

ONIONS

As no satisfactory machine for the purpose has been devised, the outer discolored portions of onions must be removed by hand. They are then sliced with a rotary slicer, a hand apple slicer such as is shown in figure 5, or by hand. Blanching is not necessary, and the slight improvement in color which it gives is more than offset by the loss of soluble constituents into the water used for dipping. The onions should be spread on trays as rapidly as they are sliced and immediately placed in the evaporator. The temperature in the drier should be 140° F. when the onions are placed in it and should be held at this point throughout the drying. The product must be carefully watched toward the end of the process, as thin detached pieces rapidly scorch unless mixed with

the thicker compact slices. The product is dry when pieces break crisply on bending, and it should be promptly removed to guard against overdrying.

The evaporator may also be used for curing onions to prevent storage rots and to prolong their season of storage. Alternate trays of the drier are used and the onions are loosely piled upon them to a depth of 4 to 6 inches. The ventilators are wide open and a very small fire, just sufficient to maintain a temperature of 95° to 100° F., is started in the furnace. The drying is continued until the outer scales are quite firm and hard and the onions have lost 8 to 10 per cent of their weight, after which they are stored in the usual manner.

SWEET POTATOES

The evaporator may be of service in preserving sweet potatoes in two ways—by drying them ready for use or by curing or partially drying them to increase the time during which they may be kept in storage in the fresh condition.

Sweet potatoes intended for drying may be prepared in the general manner outlined for other root vegetables in so far as washing and paring are concerned. They may be cut into slices, like white potatoes or carrots, or split lengthwise into quarters or eighths according to size and dried in that form. If sliced, 6 to 8 minutes is sufficient for blanching; if cut into quarters the time should be increased to 10 minutes, as the potatoes must be partially cooked. The temperature of the drier may be 145° to 150° F. at the beginning of the drying and raised 10 or 15 degrees after the product loses most of its moisture. Sweet potatoes should remain in the drier until the pieces have become quite brittle and break readily under pressure.

In humid districts in which the storage period for sweet potatoes is comparatively short, an evaporator may advantageously be used for partially drying or curing potatoes to increase their keeping period. The potatoes are brought from the field or market, spread upon the trays one or two deep, and placed in the drier, which is kept at a temperature of 90° to 100° F. by slow, careful firing. After 48 to 72 hours of this treatment the potatoes will have lost 10 to 15 per cent of their weight and will have become slightly shriveled superficially. All cuts or broken surfaces will have dried out. The potatoes are then removed and stored in bins or cellars in the usual way. The ordinary fungi which cause rotting in storage do not attack potatoes which have been subjected to this treatment, while the cooking qualities and flavor of the potatoes are entirely unaffected by it.

PUMPKIN AND SQUASH

Pumpkins used for drying may be of any variety, but the firm, solid-fleshed, deep-colored varieties will give a larger yield of a more

highly flavored and consequently more desirable product. Either summer squash or the later maturing varieties may be dried. In any case the vegetables should be mature and in good condition for use fresh. The treatment given pumpkin and squash is identical. The vegetable is cut into strips 2 inches wide and peeled, the seeds are removed, and the strips are passed through a rotary slicer set to cut pieces one-half to five-eighths inch in thickness. The pieces are immediately blanched, either in boiling water or steam, for three to six minutes. The different varieties which are used vary so much in the character of their flesh and the amount and depth of their coloration that the operator must necessarily learn by a little experimentation the best length of time for blanching the particular lot of material on hand. The process is completed and must be stopped as soon as the pieces have become semi-transparent.

The drying should be begun with a temperature of approximately 135° F., which may be gradually increased to 160° as the material dries. The trays should be looked over once or twice, in order that any moist spots may be opened up and spread out. Pumpkin and squash should not be dried until brittle; the material is in proper condition for removal from the evaporator when the pieces have become leathery in texture, but show no moisture when cut across and crushed.

TOMATOES

Fruit intended for drying should be well ripened but still firm. Wash the tomatoes, place in a wire basket, and submerge in boiling water for one or two minutes, to loosen the skins. Remove and allow to cool, strip off skins, remove the hard, woody central core and any adhering skin or diseased areas, and cut the fruit into slices three-eighths to one-half inch in thickness. Spread the slices in a single layer upon the trays. Tomatoes can not be placed directly upon naked wire trays, as the acids of the fruit become so concentrated during drying that the metal is rather vigorously attacked. Trays may be protected by painting them over with a brush dipped in boiling paraffin or by laying pieces of cheesecloth over them.

The temperature at the beginning should not be more than 120° F. and may be gradually increased to a maximum of 140° toward the completion of the drying.

Properly dried tomatoes as taken from the drier will show no moisture on being pressed between the fingers, and the slices will break crisply on bending. Like all other vegetable products, they will become somewhat flexible and elastic after being shoveled over for some days in the curing room.

OKRA

The younger pods of okra may be dried entire after being steamed or blanched in boiling water for two to three minutes, while older pods should be split into halves, or if quite large, into quarters, and blanched for two minutes. Spread thinly on trays, so that the pods do not overlap. Begin the drying at 115° to 120° F. and gradually increase it to not more than 135° as the drying proceeds.

SWEET CORN

While formerly very widely practiced throughout the country, the drying of sweet corn has in recent years been practically discontinued except in a few localities in Pennsylvania and Ohio, where the product is for the greater part consumed in the immediate vicinity. That the product and the processes for making it are not widely known is extremely unfortunate, since properly dried sweet corn is a delicious food, fully equal, if not superior, to canned corn and capable of use for practically as wide a variety of purposes.

Any of the varieties of sweet corn having qualities desirable for table use will make a good product. Where corn is grown especially for drying, Stowell's Evergreen is largely employed because it gives heavy yields of excellent quality; also because it ripens quite uniformly and hence can be gathered with a minimum of labor.

Corn intended for drying should be gathered when in the milk stage, before glazing and hardening have begun and when the corn is in ideal condition for immediate table use. It should be gathered only as rapidly as it can be worked up at the drier and must never be allowed to remain standing in bags or boxes in the field or at the drier. This is imperative, as no product deteriorates more rapidly on standing in a warm place.

The ears are husked and trimmed with a knife to remove any worm injuries, but no effort to remove adhering silks need be made, as these are readily separated from the grains after drying. The ears are then placed in wire baskets or wire-bottom boxes and plunged into boiling water for 8 to 12 minutes. The cooking is completed when the milk is "set," that is, when no fluid escapes from the grains upon cutting them across. Younger corn will require a longer period of cooking than the more mature ears, so that the corn may very well be divided in husking into older and younger lots, which are cooked separately.

After cooking, the corn is emptied upon a table, allowed to drain and cool sufficiently to be handled, and then cut from the cobs with a strong, sharp knife. The knife should be so held that none of the cob is removed with the kernels. The adhering glumes, like the silks, are easily screened out after the corn becomes dry. The kernels are spread

upon trays to a depth of 1 inch and dried at 130° to 140° F. The grain should be thoroughly stirred several times during the drying, to separate any adhering masses and equalize the drying. Properly dried corn is hard and semitransparent, and the kernels break with a clean, glasslike fracture when crushed.

BEANS AND PEAS

Garden peas intended for drying should be gathered when in ideal condition for immediate table use, that is, when the seeds have attained full size and before the pods have begun to turn yellow and dry up. Shell them by placing the pods in boiling water for five minutes, then spread on a wire screen having a mesh large enough to permit the shelled peas to pass through, with a box or basket placed beneath it. Rub the pods vigorously over the screen with the hands, which will burst and empty practically all the pods much more quickly than they could be shelled by hand. The shelled peas are then given a very short dip, one to two minutes, in boiling water, drained, spread to a depth of three-fourths inch to 1 inch on the trays, and dried at 115° to 120° F. as initial temperature, rising to 140° toward the completion of the drying. Stir occasionally while drying. Properly dried peas will be uniformly dry throughout, showing no moisture near the center when split open.

Wax beans, Lima beans, or mature string beans for drying should be gathered when full grown but before the pods have begun to dry, shelled, blanched three minutes in boiling water with thorough agitation, dried, and spread on trays to a depth of not more than 1 inch. They should be stirred rather frequently in the first hours of drying. Considerable variation in the temperatures employed in drying is permissible, but the material should not be heated above 150° F. at the outset.

String beans not yet full grown but sufficiently developed for table use are strung, broken into pieces each containing not more than two beans, and dipped into vigorously boiling water for five minutes if very young, for seven to eight minutes if older and nearly grown, in water which has had two tablespoonfuls of ordinary baking soda to each gallon added to it. This will preserve the bright-green color of the pods quite perfectly. Spread about 1 inch deep on trays and begin drying at 130° F. Stir occasionally and increase the temperature very gradually to 140° or 145°. The drying is complete when no moisture can be expressed from freshly broken pieces. Beans and peas which have been allowed to dry on the vines may advantageously be given a short treatment in the drier. Shell, spread to a depth of one-half to three-fourths inch in trays, and place in the drier for 10 to 15 minutes at 165° to 180° F. This treatment will destroy insect eggs and bean weevils.

thus reducing the possibilities of loss in storage; but it also destroys the vitality of the material treated, which consequently can not be used for seed.

CELERY

To make an acceptable dried product, the celery used must be such as would be accepted without question for use fresh. Consequently, it must reach the drier without having been allowed to become heated and wilted in the crates. All diseased and discolored parts are removed, the leaves are stripped off, and the stalks cut by means of a rotary slicer into pieces about three-fourths of an inch long. These are steamed three minutes or given a dip of two minutes in boiling water, spread about one-half inch deep on trays, and dried at 135° F. with occasional stirring. If desired, celery leaves may be dried separately from the stalks, for use in flavoring soups and stews. They may be passed through the rotary slicer or dried entire. Blanch two minutes, spread thinly, and stir frequently, employing a temperature of 125° to 140° F.

SPINACH

Spinach intended for drying should be allowed to become rather well grown, as very young spinach does not give uniformly good results. The material is sorted over, separated from the roots, thoroughly washed, drained, and steamed for not more than two minutes. In dealing with any of the thinner leaf vegetables it is advisable to employ steaming rather than dipping, since such materials retain so much water between their surfaces that the drying is very uneven. Dry at 130° F. and remove before the leaves become so dry as to break into pieces at a touch.

TREATMENT OF PRODUCTS AFTER DRYING

After removal from the drier, fruits or vegetables must be subjected to an after-curing or conditioning process before they are permanently stored away. Any lot of material, even that removed from a single tray, will not be uniformly dry throughout, some portions being over-dried while others contain too much moisture for safety. If such material while still warm be piled loosely upon a clean floor and subsequently thoroughly stirred at daily intervals for ten days or two weeks, the wetter portions give up some of their water to the drier parts or to the atmosphere, the moisture content of the entire mass becomes uniform, and a condition of equilibrium with the surrounding air such that the material neither absorbs nor gives off measurable quantities of moisture is presently attained. Material so treated is said to have been "conditioned" and may be stored without danger of spoilage; without such treatment the spores of fungi and bacteria

present upon the material will be able to begin growth upon the wetter portions, ultimately destroying the whole. Proper handling in the conditioning or curing room will permit considerable latitude in the moisture content of the material as it comes from the drier, but no one should presume upon this fact so far as to relax his efforts to remove the various products from the drier when in just the right condition.

The curing room should be conveniently located with reference to the drier, should have over all the windows blinds or shutters which effectively exclude sunlight or strong daylight, and should be closely screened to exclude insects, as the dried products will quickly change color if exposed to strong light, while the visits of insects will expose the whole product to ruin by insect larvæ later on. The floor of the room should be kept scrupulously clean, and may be divided into a number of temporary bins for the storage of the various products by means of boards placed on edge, or a number of large boxes may be used as storage bins. No harm will be done if the product of several days' drying is dumped into a single bin as it is made and the whole thoroughly stirred together; on the contrary, such treatment hastens the equalization of moisture throughout the whole mass.

Only after any given lot of material has reached such condition that it is undergoing no perceptible change in moisture content from day to day should it be placed in the containers in which it is to be permanently stored. (Fig. 13.) This is imperative. Much loss of time, labor, and material has resulted in previous seasons from a general misapprehension as to the purpose in view in permanent storage. Material which has been properly dried has nothing to fear from the free access of the air; in periods of damp weather it will take up very slight amounts of moisture, which will be as promptly lost upon the return of dry weather. The sources of possible injury to properly dried material are (1) light, which darkens light-colored products, such as apples and turnips, and causes gradual bleaching of such highly colored materials as beets, carrots, and pumpkin, and (2) insects, which deposit their eggs in the material. Consequently, the containers used for storing dried products need not necessarily be air-tight, but it is necessary that they exclude light and insects. In many cases the use of air-tight containers has unquestionably led to the loss of the material which they were intended to preserve; in periods of warm weather water was evaporated from the contents into the imprisoned air and subsequently deposited upon the surface of the material when cooler weather returned. This process of alternate distillation and condensation ultimately brought to the superficial layers so much moisture that the growth of organisms and consequent spoilage of the material became possible.

A considerable variety of containers for dried products may be used—stout paper bags, lard cans or any similar tin cans with reasonably close-fitting slip covers, heavy pasteboard boxes, or heavy muslin bags which have been repeatedly dipped into boiling paraffin prior to use (until the cloth is thoroughly infiltrated and its meshes filled) have all given satisfactory results. For stor'ng larger quantities, well-made wooden boxes of suitable size and provided with close-fitting lids may be used. Each box should be lined with several layers of paraffined paper, each layer being so placed that the sheets break the joints of the preceding layer, and the edges of the paper being left to project far

FIG. 13.—Packing the dried products, after conditioning, into pasteboard containers for storage

enough to allow them to be snugly folded over the top when the box is filled. In packing the larger containers, the material may advantageously be pressed firmly down with the hands or by means of a board cut to fit inside the container.

With materials which have been dried in the sun or by means of an electric fan, special precautions are necessary, since such materials very commonly contain the eggs of certain moths and beetles which will subsequently develop within the packages unless steps are taken to destroy them. This is best done by spreading the dried product in thin layers in ordinary baking tins or other convenient receptacles, placing these in the oven of the cookstove with a thermometer so placed that it may be observed through the partially opened door of the oven, and allowing the material to remain until the temperature has reached 180° F. This temperature will destroy all insect life. The material should be placed in packages as soon as it is removed from the oven in order that no opportunity for reinfestation may be given. The same precaution should be taken with any material which may have been exposed to the visits of insects subsequent to drying.

The room in which dried fruits and vegetables are to be stored must be warm and dry. The ordinary pantry or storeroom communicating with the kitchen is not well suited to the purpose, since the constant evaporation of water from vessels on the stove keeps the air quite humid, and evaporated materials consequently take up moisture and ultimately spoil. An airy attic which is kept warm by flues or pipes passing through it from the living rooms below makes an ideal storage place; the bags or boxes of dried products may be placed near the pipes so that they are kept slightly warm. If the house has a furnace, open shelves may be constructed near it in order that the material may be kept dry and warm by the heat of the furnace.

In districts which have exceptionally long periods of high humidity and almost constant rainfall at certain seasons, it will be necessary to employ special care in order to avoid spoilage of dried material. At such seasons, the packages of dried fruits and vegetables should be opened and examined, and any which appear to be taking on moisture should be returned to the drier or to the oven of the cookstove and given a sufficient heating to restore them to their original condition. One such treatment in the course of the rainy season is usually sufficient to prevent any loss, but the material should be examined from time to time and given a second treatment in case any portions of it appear to be too moist for safety.

MAKING SOUP MIXTURES

The various evaporated vegetables may, of course, be used separately in cookery in most of the ways in which fresh materials are employed, but the dry products will undoubtedly find their widest usefulness in soup mixtures or in combinations designed for use in the preparation of the increasingly popular vegetable boiled dinner, since they permit the serving of any favorite vegetable combination at all seasons of the year. The various vegetables, after drying, may be mixed in definite proportions prior to storage, or they may be stored separately and mixed a little at a time as needed for use.

For those who wish to make a vegetable mixture which will have the maximum food value and at the same time approach as nearly as possible to a complete or balanced ration, the formulæ employed in the making of evaporated soup mixtures for the use of the British armies may serve as guides. One of these mixtures contains 20 per cent each of potatoes, turnips, and peas, 17 per cent each of carrots and beans, and 6 per cent of onions; another has 37 per cent of potatoes, 19 per cent each of carrots and turnips, 10 per cent each of onions and cabbage, and 2½ per cent each of beans and peas.

A number of commercial concerns have placed dried vegetable soup mixtures upon the market, and while the exact proportions of the various constituents entering into these are guarded as trade secrets by the makers, they differ principally from the formulæ given in having, in most cases, a larger percentage of potato, in the absence of beans and peas, and in having various minor additions, such as beets, celery, radishes, and tomatoes. The housewife may ascertain the approximate amounts of each of the fresh materials represented by a convenient quantity, such as 1 pound, of each dry product, from the list on page 61, and with these equivalent values in mind may work out any desired combinations as readily as with fresh vegetables.

In making up combinations of dried vegetables, however, it must be borne in mind that, since the mixture must subsequently be soaked and cooked as a unit, only such vegetables as absorb water and become cooked at approximately equal rates can be successfully combined in the dry condition. Such materials as the root vegetables, cauliflower, cabbage, celery, spinach, tomatoes, and onions behave alike both in their absorption of water and in cooking; hence, any combination desired may be made from them. Peas and beans, whether mature or dried green, absorb water very much more slowly and must be cooked for two to three times as long as the materials in the list just given. For this reason they can not be mixed with other vegetables prior to soaking. Instead, they should be separately soaked and subjected to

partial cooking; then the other vegetables desired in the mixture, after previous soaking, may be added and the whole cooked until done.

YIELDS OF DRY PRODUCTS

It must be understood that any statements of yields of dry products from a given fruit or vegetable must necessarily be regarded as approximations, since there are a great number of factors which may influence the yield. Closely related varieties show specific differences in moisture content, while the same variety will vary considerably in this respect with age and degree of maturity, as well as with differences in amount and distribution of the water supply and other environmental factors. The presence or absence of disease and the degree of care employed in trimming and paring will also, of course, affect the yield. For this reason the figures given are merely indicative of what may be expected as average returns from materials of good market quality, reasonably free from diseased and dead portions, when care is exercised to avoid unnecessary waste in preparation for drying.

Yields of dry products per hundred pounds of fresh material

	Pounds		Pounds
Apples, late autumn and winter varieties	12 to 15	Okra	10 to 11
Apples, summer varieties	10 to 12	Onions	9 to 11
Apricots	16 to 18	Parsnips	20 to 22
Blackberries	16 to 20	Peaches	13 to 16
Beans	11 to 13	Pears	18 to 22
Beets	14 to 17	Peas, garden	22 to 25
Cabbage	8 to 9	Potatoes, sweet	30 to 35
Carrots	10 to 12	Potatoes, white	23 to 25
Cauliflower	12 to 14	Prunes	30 to 33
Celery	8 to 9	Pumpkin	6 to 8
Cherries, pie	17 to 21	Raspberries	17 to 23
Cherries, sweet	22 to 26	Spinach	8 to 10
Corn, sweet	26 to 33	Squash	7 to 9
Figs	18 to 23	Tomatoes	6½ to 9
Loganberries	17 to 22	Turnips	7 to 8

Farm and Home Drying of Fruits and Vegetables

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